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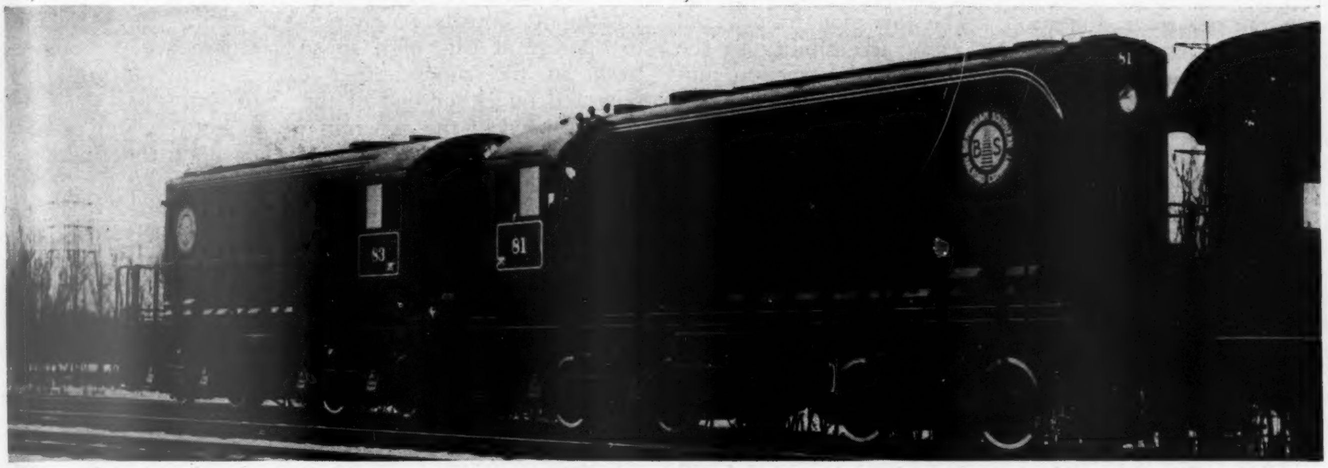
RAILWAY
MECHANICAL ENGINEER



Two of the 900-hp. units operating in multiple on a test run

Birmingham Southern Installs Five

900-Hp. Diesel Switchers

Designed for heavy transfer work and multiple operation as 1,800-hp. units when desired. Prime movers are standard Alco 600-hp. engines with superchargers

LATE in March of this year the Birmingham Southern placed five Diesel-electric transfer switching locomotives in service which were built at the Schenectady plant of the American Locomotive Company. Each of the five units is equipped with a supercharged Alco railway-type engine supercharged to develop 900 hp. Inasmuch as the service for which these units were built makes it desirable to operate two of them as 1,800-hp. switchers they are equipped with multiple control. The overall length of each single unit is 43 ft. 3 in.; the total weight, 230,000 lb., and the maximum starting tractive force, 69,000 lb. The locomotives are designed for a maximum speed of 60 m.p.h.

Mechanical Equipment

The underframe is constructed of heavy plate and sections welded together. The particular feature of this underframe is the heavy center or backbone section, especially designed for withstanding heavy shocks and collisions. The operating cab is located at one end, while the hood construction is kept as narrow as possible, giving maximum visibility along the track.

The control stand is conveniently arranged on the right side of the operator's cab. All control switches, throttle and air-brake levers are mounted in this one unit, giving a clean appearance and a general absence of piping. The doors are of heavy steel plate. Side windows are suitably located for the engineman. All operating details within the cab have been carefully laid out, primarily based on steam-locomotive practice, which has been determined by the trial-and-error method over a period of many years of operation. The seats and arm rests are suitably upholstered to give the engineman and fireman the utmost in comfort.

The fuel tank is located underneath the operating cab and contains 500 gallons, which is ample for general operating conditions. Sand boxes having ample capacity are provided both front and rear. A feature in the operating cab is the use of electric heaters which give full output regardless of engine speed or temperature of cooling water. The Diesel engine is started by pushing in a small button on the control stand which throws the current from a heavy-duty battery across the main generator, thereby electrically starting the engine.

Trucks

The power trucks, two in number, are of the four-wheel center-bearing type, having a special design of cast-steel bolster. Single, long, semi-elliptic springs, one suspended by hangers in each side-frame casting, carry the load. Each truck equalizer, or what in this case may more properly be termed the side frame, is a steel casting at each end of which is the truck-box pedestal. The bolster casting is designed to form the nose mounting for the two traction motors on each truck and two brake cylinders are mounted outside of the

springs. The ends of the longitudinal side extensions of this casting carry vertical wearing pads bearing against similar pads on the side frames just inside the truck boxes. These keep the truck square in horizontal alignment without interfering with vertical flexibility.

The principal feature of this truck is that the construction provides for positive equalization at all times without the distortion of any truck members regardless of any uneven track condition. The low side frames and absence of end frames allow ready accessibility to the inspection covers and oil reservoirs of the traction motors. The brake rigging is all placed on the outside of the truck so that brake adjustments, inspection and brake-shoe renewals can be made with a minimum loss of time.

The axles are of open-hearth forged steel finished for truck and motor bearings, wheel and gear fits, and the journals are 8 in. by 14 in. The rolled-steel wheels are 40 in. in diameter.

Diesel Engines and Supercharger

The Alco 900-hp. Diesel engine is, from the standpoint of dimensions as well as maintenance, the same as the Alco 600-hp. engine, but includes a supercharger. The American Locomotive Company has found that this engine can be converted to produce a maximum of 1,200 hp. simply by adding a supercharger and slightly modifying certain features of the engine, such as the camshaft timing, compression ratio and the exhaust and intake manifolds. The supercharger on these engines is the result of five years of development work on the part of the American Locomotive Company in adapting a turbo-blower originally designed and built jointly by Dr. Buchi, a consulting engineer, and Brown, Boveri & Co., Ltd., to the Alco standard 600-hp. locomotive Diesel engine.

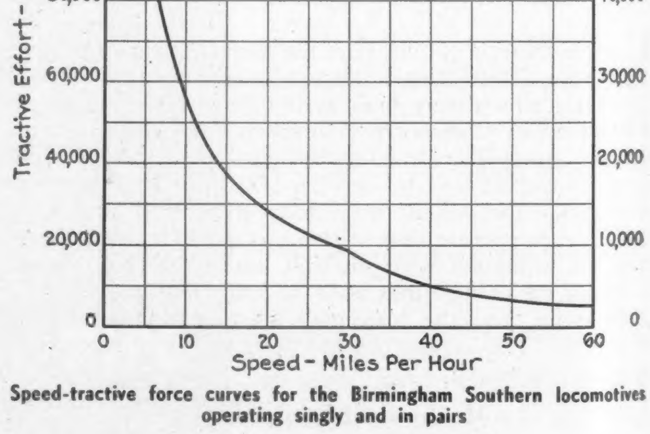
Table I — General Dimensions of Birmingham Southern Locomotives

	900 hp. (One unt)	1,800 hp. (Two units in multiple)
Length overall, ft. and in.	43-3	86-6
Width overall, ft. and in.	10-0	10-0
Height from rail (max.), ft. and in.	14-8½	14-8½
Wheel base, rigid, ft.	8-0	8-0
Wheel base, total, ft. and in.	28-6	72-6
Truck wheels, diameter, in.	40	40
Total weight locomotive, lb.	230,000	460,000
Weight on drivers, lb.	230,000	460,000
Starting tractive force, lb.	69,000	138,000
Maximum speed, m.p.h.	60	60
Minimum radius curvature, locomotive alone, ft.	50	90

After changing over the standard 600-hp. locomotive engine the operation is as follows: When the engine is idling the exhaust gases pass out of the cylinders into the exhaust manifold, which is actually in two parts, each part taking care of three cylinders. These gases then pass into the turbine side of the supercharger and through the turbine, revolving it at approximately 3,000 r.p.m. The exhaust gases, after going through this single stage row of turbine blades, then go directly up and out to the atmosphere. On the same shaft with the turbine is also mounted a turbo blower. This centrifugal-type blower draws air in through a specially designed filter and forces it into the intake manifold. The supercharger is, in effect, mounted in place of the muffler and, while the exhaust gases are coming out of one cylinder through the turbine, the blower is forcing pure air under pressure into another cylinder, the timing of which is handled by the cam shaft.

When the engine throttle is open and the governor set for a higher engine speed, more exhaust gases are produced and under a higher pressure, although only slightly above atmospheric pressure. The increased exhaust-gas volume in turn produces additional power in the turbine, which automatically speeds up the turbine and thereby pulls in more air, forcing it under a higher pressure into the intake manifold and then into the proper cylinders. When the engine is operating at full speed (700 r.p.m.) and full rated load (900 hp.) the supercharger is revolving at approximately 12,000 r.p.m. It is possible to operate at this high speed as there are no wearing parts in the supercharger except two bearings, one mounted on either end of the shaft.

The speed of the supercharger is entirely independent of engine speed and simply depends upon the amount of exhaust gases forced into it. This exhaust gas is forced in under a pressure of one or two pounds, while the blower forces the air into the engine under a pressure of two to four pounds. This method of supercharging completely scavenges the cylinder and cleans out any impure exhaust gases left in it. This is due to the fact that the intake valves are open just before the exhaust valves are closed. After the exhaust valves close the piston, on its way down, does not suck in air but the



Speed-tractive force curves for the Birmingham Southern locomotives operating singly and in pairs

supercharger forces the air in, so that there is a slight pressure on the top of the piston as it is on its way down. After the piston has reached the bottom of its intake stroke the intake valve closes, the result being that more air has been enclosed within the combustion chamber than would be the case without the supercharger. The piston then comes up on its compression stroke and, because of the increased amount of air, more fuel oil must be injected in order to obtain the proper ratio of fuel oil and air. This results in an increase of power. After the piston has been forced to the bottom of the stroke the exhaust valve is open and, as the piston comes up, it forces the exhaust out through the exhaust pipe into the turbine side of the supercharger. Through exhaustive tests it has been found that this increase of power does not produce an increase in the maximum pressures exerted upon the bearings, but simply produces an increase in the average pressures, giving a considerably higher mean effective pressure but not any higher max-

imum pressure. This is partly due to the fact that the air blown into the cylinder not only forces more air into this cylinder but also cleans out the cylinder. The resultant expansion within the cylinder deals entirely with pure air having a relatively slow, even-burning effect, rather than with air partly mixed with impurities, as the case in engines not supercharged.

Electrical Equipment

The electrical equipment consists primarily of Westinghouse main and auxiliary generators and traction motors, together with the various auxiliary units. The main and auxiliary generators are overhung from the engine and directly bolted by a solid coupling to the main engine shaft. The main generator delivers its entire output to the traction motors and is especially designed for heavy transfer service. The auxiliary generator is of the constant-voltage type (125 v.), maintaining voltage irrespective of engine speed. The auxiliary generator furnished current for the charging of the 56-cell heavy-duty starting battery, as well as the power to the auxiliaries, which include air compressors, radiator fan motor, traction-motor blower motor, fuel booster pump and cab heaters.

There are four single-geared commutating-pole-type traction motors, each supported on a truck axle, to assure the gear and pinion alignment, and on the truck bolster by means of a motor-nose spring support. The motor losses, particularly at high tractive forces, are relatively low per horsepower input.

The entire control of the locomotive is embodied in the operator's throttle which simply regulates the speed of the Diesel engine. Reversal is effected by a seperate lever operating a master controller. The motors are operated in series at low speed and are automatically changed by a voltage relay to series parallel and again automatically changed to field shunt for high locomotive speeds. When locomotives are being operated in multiple, all controls are handled at one control stand. The other control stand in the other units is locked and does not function, but the controls on that unit function in synchronism with the controls on the unit on which the operator is located.

Conclusion

The locomotives are equipped with air-operated horn, fire extinguisher, meters, etc. A special feature includes placing the handrail on the extreme sides of the runway of the locomotive, allowing the engineman and fireman freedom to walk along the hood of the locomotive when in operation. By reducing the width of the hood as much as possible to increase visibility along the track, extra width is provided in the walkway.

Two Westinghouse D-4-P air compressors are used to give a total of 100 cu. ft. per min. regardless of whether the Diesel engine is idling or operating at full speed. The air reservoirs are of exceptionally large capacity, containing 72,500 cu. in. Four air-brake cylinders, 12 in. by 10 in., are used. These cylinders are mounted on each side of each truck, taking care of equalization of braking entirely through air pipes. Automatic and straight-air brakes are used, operated through Schedule EL-14 equipment.

The fuel consumption of these locomotives is approximately 8 gallons per hour, which, of course, varies, depending upon the amount of work performed, between 6 and 12 gallons per hour. The lubricating-oil consumption of these locomotives is not exceeding the lubricating-oil consumption of the Alco 600-hp. locomotive.

It is said that the exhaust temperatures on the 600-hp. engine when supercharged and delivering 900 hp. is slightly less than when the same engine is not supercharged. Therefore, since the engine temperature is one of the factors affecting the life of Diesel engines, it is expected that the maintenance cost of this supercharged engine will be no greater than for the same engine not supercharged. The only additional maintenance cost expected is that for the supercharger itself, which on foreign installations has given long service and has required inspection but once each year.

The power plant undergoing shop tests—The supercharger is seen above the main generator

Tentative Programs of

Mechanical Associations

Several of them meet in Chicago, the latter part of next month, with an extensive joint exhibit in the Hotel Sherman

All of the mechanical-department associations faced serious difficulties during the depression. Some of them made little or no effort to hold annual meetings, while others struggled along, dropping some of their meetings and holding others of a small and limited nature. As business in general has improved and railroad traffic has increased, it has been recognized by higher executive officers as well as by the officers of the associations, themselves, that it would be well to revive and re-establish them on a sound basis.

While these mechanical associations do not have the responsibility for developing standards and recommend practices which are made official by the Association of American Railroads, they do have a very large influence in improving the efficiency and effectiveness of the mechanical department, by acting as clearing houses for the best information concerning the practices of the various highly specialized and important groups which they represent. The necessity for such associations under normal conditions has always been recognized, but it is particularly pressing at the present time, when emerging from the depression finds the railroads with many foremen, supervisors and officers who have been elevated to their positions during the past few years and have not had the opportunities for broader contacts that were available to their predecessors. Coming together in annual meetings, with an exhibit showing the latest developments in their respective fields, these men are much better equipped to administer their departments effectively than if they remain isolated and do not have an opportunity of comparing notes and discussing their problems with men engaged in like work, on other parts of their own road or on other railroads.

The officers of the Mechanical Division have apparently felt that there was a possibility that some of the mechanical associations had either outlived their usefulness or that their purposes could be better carried forward by having some of them consolidate. Four of the associations are definitely committed to conventions in September. These include the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the International Railway General Foremen's Association and the Master Boiler Makers' Association. The International Railway Master Blacksmiths' Association has decided not to hold a convention this year, and there is still some question as to whether the American Railway Tool Foremen's Association will meet.

A committee which was appointed to study the coordination of the various mechanical associations and which was responsible for bringing about the consolidation of the Traveling Engineers' and the Fuel Associations, has accomplished one other objective which has been in the minds of many people for a long time. It has arranged, with the approval of the Mechanical Division, to have these associations meet in Chicago in the same hotel and within a period of four days, with a joint exhibit, thus relieving the railway supply manufacturers of the expense of making separate exhibits for the different associations, as was the practice when they met at different times and at different places.

Naturally, with the difficulties and changes in personnel in some of the associations, the problem faced by those in charge of the preparation of the programs for the September meetings has not been an easy one. These programs are not complete as we go to press with this number, but in order that mechanical-department representatives may have some idea of what is proposed and may make arrangements to attend these meetings, the following tentative programs are presented, with the understanding that they are in the course of building and may be changed in some respects before the time of the meetings.

Car Department Officers' Association

Gray Room, Hotel Sherman
September 28-29

The Car Department Officers' Association only adopted that name at a meeting held in Detroit, Mich., August 26-28, 1930, and so has not had much of an opportunity to make a record under the new designation. Its predecessors, however, had long and honorable careers. In 1930 its name was changed from Master Car Builders' and Supervisors' Association, which association was the result of a consolidation in 1928 of the Railway Car Department Officers' Association and the Southwest Master Car Builders' and Supervisors' Association. It dates back to 1898, when the Chief Interchange Car Inspectors and Car Foremen's Association was organized.

It will hold a two-day meeting September 28-29. The program given below is tentative. Definite acceptances have not yet been received from all of those who were invited to take part in the program. With this reservation, the program as presented must be taken in the light of what the officers have in mind in a large way, rather than for accuracy in detail.

September 28

Morning Session, 10:00 A.M.

Address by President K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific.
Address by a representative of the Association of American Railroads.
Address by R. V. Wright, editor, *Railway Mechanical Engineer.*
Report of Nominating Committee.

Afternoon Session, 2:00 P.M.

Address by C. J. Nelson, superintendent interchange, Chicago Car Interchange Bureau.

Address by W. L. Ennis, manager refrigeration and freight claim prevention, Chicago, Milwaukee, St. Paul & Pacific.

September 29

MORNING SESSION, 9:30 A.M.

Address by J. T. Gillick, chief operating officer, Chicago, Milwaukee, St. Paul & Pacific.
Address by LeRoy Kramer, vice-president, General American Transportation Corporation.
Address by A. F. Stuebing, railway mechanical engineer, United States Steel Corporation.

AFTERNOON SESSION, 2:00 P.M.

Address by W. J. Patterson, chief, Bureau of Safety, Interstate Commerce Commission.
Report of A.A.R. Committee.

The officers of the association are President, K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; first vice-president, F. A. Starr, superintendent reclamation, Chesapeake & Ohio, Covington, Ky.; second vice-president, E. J. Robertson, superintendent car department, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.; third vice-president, C. J. Nelson, superintendent of interchange, Chicago Car Interchange Bureau, Chicago; fourth vice-president, A. J. Krueger, master car builder, New York, Chicago & St. Louis, Cleveland, Ohio; secretary-treasurer, A. S. Sternberg, master car builder, Belt Railway of Chicago, Clearing, Ill.

General Foremen's Association

Rose Room, Hotel Sherman
September 28-29

The International Railway General Foremen's Association, because of the illness and retirement of its secretary, William Hall, who functioned so acceptably in that capacity for many years, has faced special difficulties in building up its program. Matters are now well in hand, however, and excellent progress has been made in whipping into shape what promises to be a practical and inspiring program.

The two-day meeting will be held on Tuesday, September 28, and Wednesday, September 29. Because final acceptances have not yet been received in all instances, the names of those who are scheduled to make the addresses are omitted, but will appear in the September number of the *Railway Mechanical Engineer.* The program is as follows:

Tuesday, September 28

MORNING SESSION

Opening ceremonies.
Address: How Can the Mechanical Supervisor Be of Greater Help to the Railroad Management?
Appointment of committees.
Address: How Long Can We Put Off Training Men, Both Mechanics and Supervisors?

AFTERNOON SESSION

Open Forum: This will be a three-hour forum discussion of questions pertinent to the locomotive back shop, enginehouse and passenger- and freight-car problems. Among the topics already listed are Controlling Waste, Winning Co-operation, Maintenance of Special Equipment on Locomotives, Care and Maintenance of Shop Tools, Improved Work Methods, and Maintenance of Freight Equipment. Suggestions are still coming in from members of the association.

Wednesday, September 29

MORNING SESSION

Address: Mechanical Supervisors and Public Opinion.
Address: Modern Methods in Freight-Car Building and Repair.

AFTERNOON SESSION

Address: Can Modern Machine Tools Cut Repair Costs?
Address: Handling Safety Problems in the Shop.

The officers of the association are President, F. T. James, general foreman, Delaware, Lackawanna & Western, Kingsland, N. J.; first vice-president, F. B. Downey, assistant shop superintendent, Chesapeake & Ohio, Huntington, W. Va.; second vice-president, J. W. Oxley, general car foreman, Chicago & North Western, Proviso, Ill.; and third vice-president, C. C. Kirkhuff, general foreman, Atchison, Topeka & Santa Fe, Corwith, Ill.

Master Boiler Makers' Association

Crystal Room, Hotel Sherman
September 29-30

The Master Boiler Makers' Association made an unusual effort during the depression to carry on its activities and succeeded unusually well, all things considered. The president, M. W. Milton, is chief boiler inspector, Canadian National Railways, Toronto, Ont.; it is quite fitting therefore, that C. C. Stibbard, chief operating officer of the Board of Railway Commissioners for Canada, has been asked to address the association.

In addition to reports from the standing committees, the National Electrical Manufacturers' Association has accepted an invitation to present a paper on metallic arc welding, and the International Acetylene Association has likewise agreed to present a paper on the use of acetylene in the fabrication of boilers and tenders. The Water Service Committee of the American Railway Engineering Association has also agreed to discuss the report on pitting and corrosion of boilers and tenders.

The committees which will make reports at the September meeting include the following:

Topic No. 1—Pitting and Corrosion of Locomotive Boilers and Tenders. Louis R. Haase, chairman, district boiler inspector, Baltimore & Ohio, Glenwood, Pa.; J. L. Callahan, service engineer, National Aluminate Corporation, Chicago; John J. Powers, system boiler foreman, Chicago & North Western, Oak Park, Ill.; Albert W. Novak, general boiler inspector, C. M. St. P. & P., Milwaukee, Wis.; Frank Yochem, general boiler inspector, Missouri Pacific, St. Louis, Mo.

Topic No. 2—Autogenous Welding and Cutting as Used in the Fabrication of Boilers and Tenders. Albert F. Stiglmeier, chairman, general boiler foreman, New York Central, West Albany, N. Y.; John A. Doarnberger, master boilermaker, Norfolk & Western, Roanoke, Va.; Gay E. Stevens, boiler supervisor, Boston & Maine, Malden, Mass.; James A. McGraulty, general foreman boiler department, American Locomotive Company, Schenectady, N. Y.

Topic No. 3—Proper Thickness for Front Tube Sheets. Walter R. Hedeman, chairman, assistant mechanical engineer, Balti-

more & Ohio, Baltimore, Md.; T. H. Moore, general boiler inspector, Western Maryland, Hagerstown Md.; Carl A. Harper, general boiler inspector, C. C. C. & St. L., Indianapolis, Ind.; E. C. Umlauf, supervisor of boilers, Erie, Jersey City, N. J.; and William Henry general boiler inspector, Canadian Pacific, Calgary, Alta.

Topic No. 4—Improvements of Safe Ending and Application of Flues and Tubes. Frank A. Longo, chairman, welding and boiler supervisor, Southern Pacific, Los Angeles, Cal.; Sigurd Christopherson, supervisor of boilers and maintenance, N. Y. N. H. & H., East Milton, Mass.; E. H. Gilley, general boiler inspector, Grand Trunk, Battle Creek, Mich.; J. M. Stoner, supervisor of boilers New York Central, Cleveland, Ohio; and Carl F. Totterer, general boiler foreman, Alton, Bloomington, Ill.

Topic No. 5—Improvements to Prevent Cracking of Firebox Sheets Out of Staybolt Holes. C. W. Buffington, chairman, general master boilermaker, Chesapeake & Ohio, Huntington, W. Va.; V. H. Dunford, general master boilermaker, Seaboard Air Line, Norfolk, Va.; R. M. Cooper, district boiler inspector, Baltimore & Ohio, Cincinnati, Ohio; H. E. May, general boiler and locomotive inspector, Illinois Central, Chicago; George L. Young, boiler department foreman, Reading, Reading, Pa.

Topic No. 6—What Is Being Done to Prevent Back Tube Sheets from Cracking in Radius of Flange and Out of Tube Holes. Louis Nicholas, chairman, general boiler foreman, Chicago, Indianapolis & Louisville, La Fayette, Ind.; G. E. Burkholtz, general boiler inspector, St. Louis-San Francisco, Springfield, Mo.; H. A. Bell, general boiler inspector, Chicago, Burlington & Quincy Lincoln, Neb.; and E. E. Owens, general boiler inspector, Union Pacific, Lincoln, Neb.

Topic No. 7—Topics for 1938 Meeting. George M. Wilson, chairman, general boiler supervisor, American Locomotive Company, Schenectady, N. Y.; W. H. Keiler, locomotive inspector, Interstate Commerce Commission, Omaha, Neb.; Ira J. Pool, boiler-tube expert, National Tube Company, Baltimore, Md.; Leonard C. Ruber, superintendent boiler department, Baldwin Locomotive Works, Darby, Pa.; George B. Usherwood, supervisor of boilers, New York Central, Albany, N. Y.

Topic No. 8—Law. Myron C. France, chairman, general boiler foreman, C. St. P. M. & O., St. Paul, Minn.; Kearn E. Fogerty, general boiler foreman, Chicago, Burlington & Quincy, Chicago; and L. M. Steeves, foreman boiler department, Chicago & Eastern Illinois, Danville, Ill.

The officers of the association are: President, M. V. Milton, chief boiler inspector, Canadian National Railways, Toronto, Ont.; vice-president, W. N. Moore, general boiler foreman, Pere Marquette, Grand Rapids, Mich.; and secretary-treasurer, A. F. Stiglmeier, boiler department foreman, New York Central, 29 Parkwood Street, Albany, N. Y.

Railway Fuel and Traveling Engineers' Association

Grand Ballroom, Hotel Sherman
September 28—October 1

This association was formed last September and is a combination of the Traveling Engineers' Association and the International Railway Fuel Association. Each of these associations made an excellent record in the past and was noted because of the high calibre of the addresses and reports which were made each year. The convention will extend over four days, Tuesday, September 28, to Friday, October 1, inclusive.

The meeting on the first day will be featured with an address by M. J. Gormley of the Association of American Railroads. Most of the time of the two sessions, on this day, however, will necessarily be given over to matters of organization, since this is the first meeting of the new association.

For the convenience of the members in planning to attend the convention and for those who may not be able to remain throughout, the programs for the following three days have been grouped under a "Mechanical Day," "Air Brake Day" and "Fuel Day." It is planned to adjourn early in the afternoon, as near four o'clock as possible, on each of the first three days, in order that the members may have an opportunity of thoroughly studying the exhibits.

The tentative program follows, the times given, of course, being approximate.

Tuesday, September 28

10:30 a.m.—Convention opens.
10:35 a.m.—Invocation by Dr. Bertram G. Jackson.
10:45 a.m.—Chairman's Address, by J. D. Clark, fuel supervisor, Chesapeake & Ohio.
11:00 a.m.—Address by M. J. Gormley, executive assistant to president, Association of American Railroads.
11:30 a.m.—Report of Committee on Constitution and By-Laws, presented by R. Collett, fuel agent, St. Louis-San Francisco.
2:00 p.m.—Election of officers.
Adjourn to view exhibits.

Wednesday, September 29

Mechanical Day

9:30 a.m.—Report of Committee on New Locomotive Economy Devices, presented by A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific.
10:15 a.m.—Report of Committee on Steam Turbine and Steam Condensing Locomotives, presented by L. P. Michael, chief mechanical engineer, Chicago & North Western.
11:00 a.m.—Address by Walter H. Flynn, general superintendent motive power and rolling stock, New York Central Lines.
11:30 a.m.—Report of Committee on Front Ends, Grates and Ash Pans, presented by Prof. E. C. Schmidt, University of Illinois.
2:00 p.m.—Report of Committee on Attention to Valve Motion and Its Effect on Fuel Economy, presented by M. F. Brown, fuel supervisor, Northern Pacific.
3:00 p.m.—Report of Committee on Utilization of Locomotives, presented by A. A. Raymond, superintendent fuel and locomotive performance, New York Central Lines.
Adjourn to view the exhibits.

Thursday, September 30

Air Brake Day

9:30 a.m.—Report of Committee on Air Brakes, presented by W. H. Davies, superintendent air brakes, Wabash Railway.
11:00 a.m.—Address by L. K. Sillcox, vice-president, New York Air Brake Company.
2:00 p.m.—Report of Committee on Locomotive Firing Practice—Oil, presented by R. S. Twogood, assistant engineer, Southern Pacific Company.
Report of Committee on Locomotive Firing Practice—Coal, presented by W. C. Shove, general road foreman of engines, New York, New Haven & Hartford.
Adjourn to view the exhibits.

Friday, October 1

Fuel Day

9:30 a.m.—Report of Committee on Subjects.
10:00 a.m.—Address by Eugene McAuliffe, president, Union Pacific Coal Company.
10:45 a.m.—Report of Committee on Inspection, Preparation and Utilization of Fuel, presented by W. R. Sugg, superintendent fuel conservation, Missouri Pacific.
11:15 a.m.—Report of Committee on Fuel Records and Statistics, presented by E. E. Ramey, fuel engineer, Baltimore & Ohio.

11:35 a.m.—Report of the Secretary-Treasurer, T. Duff Smith.
12:00 m. —Report of Finance Committee.
12:15 p.m.—Other business.
2:00 p.m.—The entire afternoon will be available for visiting the exhibits.

The officers of the association are: President, J. D. Clark, fuel supervisor, Chesapeake & Ohio, Richmond, Va.; vice-chairmen, C. I. Evans, chief fuel supervisor, Missouri-Kansas-Texas, Parsons, Kan.; A. T. Pfeiffer, road foreman of engines, New York Central, Syracuse, N. Y.; and F. P. Roesch, vice-president, The Standard Stoker Company, Inc., Chicago, Ill.; and secretary-treasurer, T. Duff Smith, 1255 Old Colony Building, Chicago, Ill.

Large Exhibit Planned by Railway Supply Companies

September 28—October 1

It is planned to provide an unusually large and comprehensive exhibition of railway equipment and supplies, a study of which will prove an important supplement to information secured by railroad men in their respective technical sessions.

Owing to the fact that the mechanical associations have arranged to hold simultaneous sessions at a central city like Chicago, which can conveniently be reached from all points in the West and Middle West, it is anticipated that the attendance of mechanical department officers, and especially those in the lower ranks, will actually exceed the total attendance of railroad men at the Atlantic City convention in June.

The exhibition of railway locomotive and car equipment and supplies will be very extensive in scope, about 40,000 sq. ft. of exhibition space being available in the exhibit hall and on the mezzanine and lobby floors of the Hotel Sherman. The indications are that about 150 manufacturers and distributors will take advantage of this opportunity to exhibit their products to mechanical-department officers of all ranks, and particularly those in the lower brackets, many of whom, while keenly interested in the performance of railway mechanical materials and specialties, were unable to attend the Atlantic City convention. At least 45 manufacturers and supply companies have already signed up for exhibition space.

The railway exhibit at the Hotel Sherman in September is being sponsored by the Allied Railway Supply Association, Inc., which consists of the following: Air Brake Appliance Association; Association of Railway Supply Men, associated with the International Railway General Foremen's Association; Boiler Makers' Supply Men's Association; International Railway Blacksmiths' Supply Association; Railway Fuel and Traveling Engineers' Supply Association; the Supply Men's Association, associated with the Car Department Officers' Association.

The officers of the Allied Railway Supply Association, Inc., are: President, E. S. Fitzsimmons, Flannery Bolt Company, Bridgeville, Pa.; first vice-president, L. B. Rhodes, Vapor Car Heating Company, Washington, D. C.; second vice-president, J. W. Fogg, MacLean-Fogg Lock Nut Company, Chicago; third vice-president, C. F. Weil, American Brake Shoe & Foundry Company, Chicago; fourth vice-president and assistant treasurer, Fred Venton, Crane Company, Chicago; fifth vice-president, M. K. Tate, Lima Locomotive Works, Inc., Lima, Ohio; sixth vice-president, H. S. Mann, Standard Stoker Company, Inc., Chicago; secretary J. F. Gettrust, Ashton Valve Company, Room 1108 New Post Office, Chicago; treasurer, G. R. Boyce, A. M. Castle & Company, Chicago.

Railway

Equipment Trends

The relative advantages of steam, Diesel and electric motive power are discussed, in the Report of the National Resources Committee. Relation of improvements in car design to increased traffic is also considered

One part of the National Resources Committee's report, recently submitted to President Roosevelt by the chairman of the committee, Harold L. Ickes, dealt with "Technological Trends and National Policy." This included a section on transportation prepared by Harold A. Osgood, vice-president of the Fulton Iron Works Company, St. Louis, Mo., with the assistance of the National Resources Committee's special committee on transportation, of which Frederic A. Delano served as chairman.

In that part devoted specifically to railway transportation much discussion is included as to the relative advantages of steam power, Diesels and electrification. The latter is called "the result of necessity rather than desire," its justification resting "far more on density of traffic than on any other factor . . . only with a large volume of business can enough operating expenses be saved to justify the increased capital charges." Also, "railroads directly serving coal mines and those whose tonnage is largely coal will not be eager to electrify as a matter of general business policy, though so great a coal carrier as the Pennsylvania has been forced to do so by special conditions." From its next observation that electrification will be confined in the main to "extremely dense traffic areas" the report goes on to list as possibilities in this connection the New York, New Haven & Hartford's line between New Haven, Conn., and Boston, Mass., and the main line of the

New York Central—although, in the latter case, "it seems improbable that the necessity for such action will arise in the next 10 or 15 years."

Of the Diesel the report says that despite their high thermal efficiency their advantages as compared with steam locomotives "for road passenger service remain to be demonstrated." Continuing, it observes that advantages claimed for the Diesel "are today largely nullified by high investment costs and fixed charges." It adds, however, that "even today the Diesel electric has many advantages in terminal service, and in that field probably lies the Diesel's best chance in the near future."

Steam Locomotive Will Hold Its Own

Turning to the steam locomotive Mr. Osgood predicts that the bulk of railroad freight will continue to be hauled by that type of motive power; and he adds that "considering the many years of research and practical experience back of steam engineering, and the cumulative and accelerating progress in this art, this is to be expected." He goes on to deny that his prediction implies "any lack of progress," for "few types of machinery have been so greatly improved in the past 20 years as steam locomotives." Even for light streamlined trains, "where popular demand seems to be for novel shapes and colors of motive power, the reciprocating steam locomotive, considering particularly its cost, offers about as much promise as the Diesel."

Freight Cars

With two million freight cars in service Mr. Osgood thinks "it is plain that changes in this class of equipment can only be made slowly." But for the development of the motor truck he believes we might have followed British practice and built small cars. However, with the traffic adapted to such equipment now largely lost to the truck, Mr. Osgood observes that "we may anticipate neither radical nor rapid changes in our freight equipment." He does believe that "a good deal can yet be done toward reducing weight, both through changes in car design and the substitution of lighter materials." The savings, however, "will be largely confined to the item of fuel, and fuel costs are now on such a low gross ton-mile basis that any car having a higher first cost will have difficulty in justifying itself."

Also, the report predicts that a new form of freight car will be worked out to carry either truck bodies or containers; but "its ultimate development waits on the determination through experience as to which of these forms of rail-and-truck co-ordinated transportation is most satisfactory. It seems unlikely that both will have a place."

Passenger Equipment

Of passenger equipment the report states that air conditioning has had a wider appeal to the traveling public than any other single development since the introduction of the steel car. Also, streamlining, "at least in appearance," is demanded by the public. Yet, the report goes on to say that the benefits of streamlining to the railroad "are generally much less than is commonly believed"; but along with bright colors it catches "the public eye and fancy"—and both "are of undoubted benefit in advertising, if not in operation." Reduction of the cross section, Mr. Osgood says, has so far been of more tangible benefit than actual streamlining; but he adds that whether the traveling public will ultimately favor cars of less than conventional width and headroom "remains to be seen." He does find, however, that "reduction of passenger car weights and dimensions is a promising field." As one of the advantages of light passenger equipment the report cites low operating costs permitting more frequent service.

Results of Refrigerator-Car

Ice-Meltage Tests

By E. A. Gorman, Jr.*

U. S. Department of Agriculture develops drip-meter for determining ice meltage in refrigerator cars. Ice meltage calculated mathematically compared with drip-meter measurements obtained from tests

During the past 30 years or more the United States Department of Agriculture has been conducting investigations on the transportation of perishables and has often been called upon as a disinterested agency to study problems with which shippers and carriers have to deal.† The results of this work have been responsible in no small measure for many significant improvements in equipment and methods of shipment as well as for effecting economies in refrigeration and transportation costs and reducing spoilage in transit. This work therefore has been an important contributing factor in the growth of producing areas far removed from consuming centers and the consequent increase in perishable railway traffic resulting therefrom.

The extent and scope of the Department's work in this field is indicated by the record for the 12-month period from November, 1934, to October, 1935, inclusive. During this period the Bureau of Plant Industry of the United States Department of Agriculture conducted 24 major tests on rail shipments of apples, cantaloupes, grapes, lemons, oranges, peaches, pears, strawberries and lettuce. The studies were made not only on precooling and transit refrigeration but also on methods of protection against freezing during winter weather. Temperatures encountered in the course of these tests ranged from 47 deg. F. below zero to 117 deg. F. above zero.

The modified forms of transit refrigeration developed in the Department's work have proved entirely adequate and satisfactory in some classes of service and have re-

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† These investigations are under the direction of D. F. Fisher, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

sulted in savings up to $40 or more per car, made up principally of savings in ice consumption. In seasons when returns are low such savings might conceivably represent the difference between profit and loss.

In the designing of new equipment and the development of icing methods for the transportation of perishable foodstuffs, measurement of ice consumption must be considered. Methods of accurately determining the rate of ice meltage during transit have not until recently been perfected to a point of reliability. It is the purpose of this article to describe briefly a method of accomplishing this which has been developed by the United States Department of Agriculture.

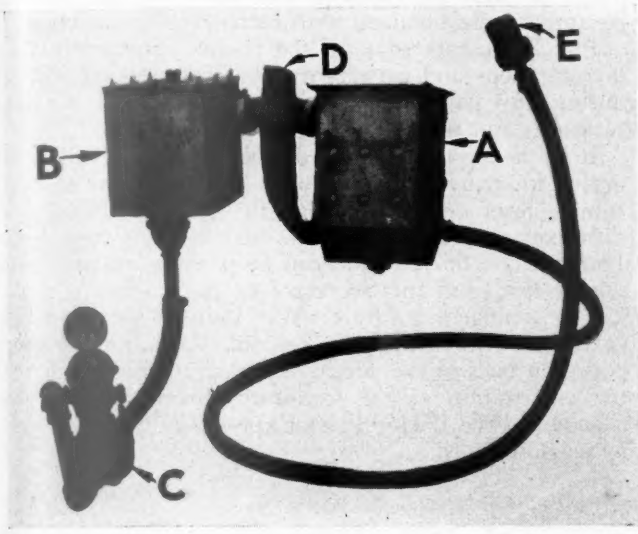

Fig. 1—The drip meter developed by the U. S. Department of Agriculture

Table I—Icing Data as Indicated by Weighing the Re-icing and by the Use of Drip Meter*

Day of test	Time of day	Total cumulative ice meltage indicated by: Meters	Re-icing	Re-icing variation from meter reading	Meltage between icings indicated by: Meters	Re-icing	Re-icing weight; variation from meter reading: Pounds	Per cent
1	3:55 a. m.†	0	0	0	0	0	0	0
1	3:55 p. m.	2,230	1,554	−676	2,230	1,554	−676	−30.0
2	12:00 m.	5,130	4,965	−165	2,900	3,411	+511	+17.6
3	5:00 a. m.	6,816	6,562	−254	1,686	1,597	−89	−5.2
3	4:00 p. m.	7,727	7,494	−233	911	93[illegible]	+21	+2.3
4	6:15 a. m.	8,751	8,455	−296	1,024	961	−63	−6.1
4	10:00 p. m.	9,745	9,456	−289	994	1,001	+7	+0.7
5	7:00 p. m.	10,919	10,638	−281	1,174	1,182	+8	+0.6
6	7:15 p. m.	12,387	12,129	−258	1,468	1,491	+23	+1.5
7	7:15 a. m.	12,933	12,821	−112	546	692	+146	+26.7
8	2:15 a. m.	13,785	13,372	−413	852	551	−301	−35.3
8	11:00 p. m.	14,577	14,070	−507	792	698	−94	−11.8

* Test run made with a car load of Valencia oranges moved in ice-bunker refrigerator cars from Los Angeles, Calif., to New York, N. Y., June, 1936.

† Time of initial icing. Initial and all re-icing weights are actual scale weights of ice supplied.

Previously, the method used for determining the amount of ice used in the refrigeration of test shipments was either to weigh it when supplied to the cars or to measure the empty space above the ice in bunkers and calculate the meltage therefrom, the full capacity of the bunkers being known. When cars move under "standard refrigeration" it is possible to determine approximately the rate of ice meltage by the amount of ice required to refill the bunkers, which under this service is done periodically about once every 24 hrs. Due to various factors the error in such records has been found to vary as much as 35 per cent in indicating meltage between re-icings (see Table I) for intermediate portions of the test. For the total ice meltage during the entire trip, however, this method can be relied upon for transcontinental shipments when the ice remaining in the bunkers at destination is carefully determined. The method is not at all applicable, however, for determining the rate of ice meltage in cars moving without re-icing in transit.

It is desirable to ascertain the ice-meltage rate with shipments of different commodities, under varying climatic conditions encountered during different seasons of the year and in cars with different types of insulation and construction. The practical method developed by the Department for obtaining such records is that of measuring the ice water running out of the drain pipes. This has been attempted by various investigators during the past 20 years or more, but few of the "drip meters" developed ever reached the stage where they could be used for road tests.

Table II—Icing Conditions for Data in Fig. 2

Car	Month	Day initially iced	Day loaded	Commodity condition	Day re-iced
A	Aug.	First (C. I.)*	Second	Not precooled	Third & seventh
A	Oct.	First (C. I.)	Second	Not precooled	Third
B	Aug.	Third (C. I.)	Second	Not precooled	Sixth
B	Oct.	Third (C. I.)	Second	Not precooled	Seventh
C	Aug.	Second (B. I.)*	Second	Precooled	Not re-iced
C	Oct.	Second (B. I.)	Second	Precooled	Not re-iced

* C. I.—Chunk ice. B. I.—Block ice.

A new type of drip meter, shown in Fig. 1, was designed and tested by the author in 1934 at the Bureau of Plant Industry cold-storage laboratory, Arlington Farm, Va. Since then a number of these devices have been

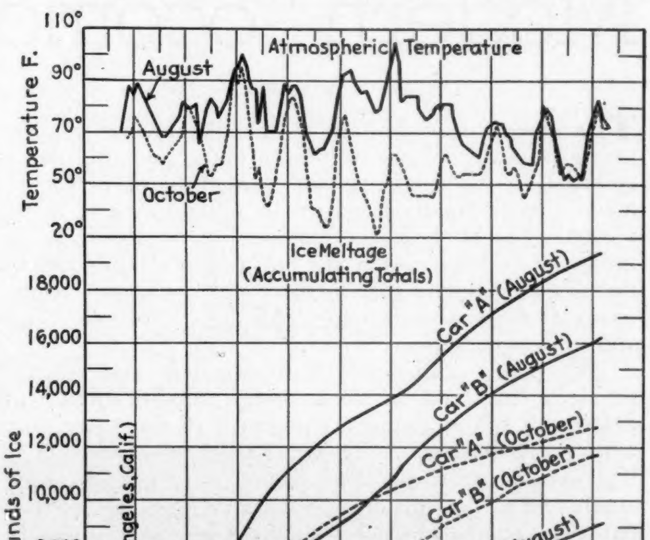

Fig. 2—Comparison of cumulative ice meltages of modified types of refrigeration in tests during August and October, 1935, with prevailing atmospheric temperatures—See Table II

used with transcontinental test shipments. In these road tests a total of 199,880 lb. of ice was melted and the individual cars were moved over a total of 102,000 miles without any serious effect on the performance of the drip meters.

The device is simple and rugged in construction and accurate in operation. As shown in Fig. 1, it consists of three parts: A filter and sediment collector *A*, an accumulating and flushing tank *B*, and a disc-type water meter *C*; *D* and *E* are hose connections to bunker drain traps. Two such devices are used per car, placed one at each end on opposite sides. Drip water from both drain pipes of the bunker is conducted to the filter tank of the meter by means of rubber hose arranged under the car end sills in a manner to avoid fouling any of the truck parts. The tanks of the metering unit are fastened to the car sills with metal strips and wedged between the side sill and the first intermediate sill of the car on the underside of the floor superstructure. The water meter is secured in a specially constructed stirrup bolted to the body bolster. All parts of the device are within the clearance limits of the particular car on which it is applied.

The water from the melting ice enters the filter or screening tanks where all foreign matter large enough to foul the working mechanism of the device is eliminated. The water then passes into an accumulating or flush tank and after rising to a sufficient height causes the operation of valves therein, releasing the stored water which runs out through the disc type water meter at a rate of flow sufficient to produce accurate registration.

In duplicate tests on orange shipments from California to New York City in August and October, 1935, ice-meltage records were obtained by means of the drip meters described. Average fruit temperatures were obtained by means of electrical resistance thermometers placed in strategic zones of the load. Outside air temperatures were obtained with mercury thermometers.

Fig. 2 presents some of the results obtained in these investigations and permits the correlation of ice meltage during any portion of the tests with outside air temperatures and temperatures inside the car.

It is believed that the device described will prove useful to many engineers who have occasion to make similar tests or to determine the relative efficiency of different cars. The drip meter is registered under Patent No. 2,057,234 and can be used by anyone securing license from the Secretary of Agriculture.

The arrangements by C. W. Mann of the U. S. Department of Agriculture at Pomona, Calif., for the transportation tests of the device described in this article, and the cooperation of the California Fruit Growers Exchange and the Pacific Fruit Express Company are hereby acknowledged.

Design Features of Lightweight

Modern Locomotive Equipment-I*

A discussion of the development and research problems involved in the design of Timken lightweight reciprocating and rotating parts for locomotives

THE steam locomotive represents the lowest first cost per horsepower of motive-power units, and this fact in addition to its reliability and versatility of power has made difficult its displacement by other forms of motive power. Lately, however, competition is requiring design modifications which are not in general use today if the steam locomotive is to meet the operating requirements at the ever-increasing high speeds in both freight and passenger service.

This paper discusses the development and research problems involved in such design modifications, and deals with the mechanical equipment of the steam locomotive. The general objects of such improvements for high-speed operation are to obtain (*a*) reduced dynamic augment on the rails due to rotating and reciprocating parts so that it will not be detrimental to the existing track structure; (*b*) improved movement of the locomotive over the track by reducing nosing and fore-and-aft vibrations, thereby reducing the forces and maintenance costs on locomotive parts and track structure; (*c*) increased availability; (*d*) reduced operating maintenance cost; (*e*) greater acceleration; (*f*) increased speeds; and (*g*) increased tractive force.

The Timken Roller Bearing Company has been dealing for years with the problems of obtaining these desired improvements in operating characteristics. Cooperation of various railroads in this development work has resulted in modifications in locomotive design incorporating the application of (*a*) lightweight reciprocating parts, including the piston, piston rod, and crosshead assembly; (*b*) lightweight main and side rods; (*c*) roller-bearing crosshead pins, main pins, side pins; (*d*) roller-bearing-equipped driver, trailer, engine- and tender-truck axles.

The beneficial results effected in locomotive operation through the application of Timken bearings to all axles are generally recognized. At the time of this writing, two main-line high-speed steam passenger locomotives have been in road service for some time with Timken lightweight revolving and reciprocating parts, including Timken-bearing-equipped crankpins and wrist pins. Service results have justified the extension of these applications to 53 additional locomotives now being built for various railroads, as indicated in Table I wherein locomotive specifications and road mileages are given. One of the applications is shown in Fig. 1.

The Importance of Lightweight Reciprocating Parts

The dynamic augment or hammer blow on the rail resulting from underbalance or overbalance of rotating parts increases with the square of the speed so that in going from 70 m.p.h. to 100 m.p.h., a speed increase of 41 per cent, twice the dynamic augment is produced. Considering that there are certain limiting combined

* Abstracted from a paper on "Modern Locomotive and Axle Testing Equipment," by T. V. Buckwater, O. J. Horger and W. C. Sanders, published in the Transactions of the American Society of Mechanical Engineers, April, 1937, and presented before the semi-annual meeting, Detroit, May 17-21, 1937.

Table 1—Comparison of Weights of Revolving and Reciprocating Parts, Dynamic Augment on Rail, and Maximum Horizontal Force on Locomotives Equipped with Plain-Bearing and Timken-Bearing Rods

Railroad	P. R. R.			N. Y. C.			U. P.			C. B. & Q.		
Type	4-6-2			4-6-4			4-8-2			4-6-4		
Class	K-4-s			J-1-E			MT-1			S-4		
Number of locomotives	1*			1†			1§			1§		
Cylinder size, in.	27 x 28			23¾ x 28			29 x 28			25 x 28		
Boiler pressure, lb. per sq. in.	205			250			200			250		
Driver diameter, in.	80			79			73			78		
	Plain	Timken	Per cent diff.	Plain	Timken	Per cent diff.	Plain	Timken	Per cent diff.	Plain	Timken	Per cent diff.
Revolving weight on pin, including crank pin, lb.: ¶												
Back	301	417	+39	298	441	+48	....‖	468	...	....‖	437	...
Intermediate	....	....	...	....	....	...	....	833	...	....	....	...
Main	1,435	1,195	–17	1,579	1,279	–19	....	1,510	...	....	1,305	...
Front	285	321	+13	320	362	+13	....	397	...	....	360	...
Total	2,021	1,933	– 4	2,197	2,082	– 5	....	3,208	...	....	2,102	...
Reciprocating weight per locomotive side:												
Total weight, lb.	1,473	977	–34	1,971	944	–52	2,012	1,083	–46	2,067	995	–52
Weight balanced on main, per cent	19.4	17.5	...	10.1	10.1	...	17.2	8.3	...	19.0	10.0	...
Total weight balanced, per cent	58.2	52.6	...	37.1	37.1	...	51.5	33.3	...	57.0	29.9	...
Unbalanced weight, lb.	615	464	–25	1,239	595	–52	976	723	–26	888	698	–21
Dynamic augment on rail at main wheel in 1,000 lb. for:												
60 m.p.h.	7.2	4.3	–40	5.2	2.5	–52	7.8	2.7	–65	10.4	2.6	–75
80 m.p.h.	12.8	7.7	–40	9.2	4.4	–52	13.9	4.9	–65	18.5	4.7	–75
100 m.p.h.	20.1	12.0	–40	14.4	6.8	–52	21.8	7.6	–65	29.0	7.3	–75
120 m.p.h.	28.9	17.3	–40	20.7	9.8	–52	31.4	10.9	–65	41.7	10.5	–75
Maximum horizontal force** on locomotive due to unbalanced reciprocating weight on both sides of locomotive in 1,000 lb. for:												
60 m.p.h.	22.0	16.6	–25	45.3	21.8	–52	41.8	31.0	–26	33.3	26.2	–21
80 m.p.h.	39.1	29.5	–25	80.7	38.7	–52	74.4	55.1	–26	59.2	46.5	–21
100 m.p.h.	61.0	46.1	–25	126.0	60.5	–52	116.2	86.1	–26	92.5	72.7	–21
120 m.p.h.	87.9	66.4	–25	181.4	87.2	–52	167.4	123.9	–26	133.2	104.8	–21

* Main-line passenger service mileage to January 1, 1937—182,000 miles.
† Main-line passenger service mileage to January 1, 1937— 81,000 miles.
‡ There are 50 new locomotives now being built; five are equipped as shown, while the other 45 have Timken reciprocating parts only.
§ Locomotives being rebuilt.
¶ Revolving weight is completely counterbalanced on all of the locomotives shown in this table. Cross-balance is used on all except the Pennsylvania K-4-s locomotive, where a static balance is used on both the Timken and plain-bearing designs.
‖ Not available.
** Note: The New York Central is building 50 new 4-6-4 locomotives, designated as Class J-1-F, with 22½-in. by 28-in. cylinders, 79-in. drivers, and 300 or 275 lb. boiler pressure; 45 of these locomotives have Timken reciprocating parts only, and 5 have Timken revolving and reciprocating parts. On the latter 5 locomotives the same revolving and reciprocating weights, dynamic augments and maximum horizontal forces apply as given for the Timken parts on the N. Y. C. 4-6-4 Class J-1-E locomotive in the table.

static and dynamic rail loads permissible on the track structure, the present motive power, with high static axle loading, does not permit doubling the dynamic augment. At diameter speed, the combined rail load is already about the permissible value.

In addition to the objectionable large dynamic augment developed at high speeds, other difficulties arise which are evidenced by increased nosing, swaying, and fore-and-aft oscillations of the locomotive. Vibrations of these types prevent smooth operation and lead to increased maintenance costs for both the track structure and the locomotive itself. The forces causing these vibrations are proportional to the square of the speed.

Driving wheels on freight engines are frequently too small to balance the rotating parts fully, so that the reciprocating weights remain entirely unbalanced. A large underbalance will result in excessive dynamic augment since every pound of unbalanced rotating parts represents a rail blow of about 50 lb. at diameter speed. In addition to this deleterious effect of large dynamic augment, this unbalance gives rise to horizontal forces which must be transmitted through the locomotive members and track structure. The maximum horizontal force on the locomotive frame, axle, and other parts is

Fig. 1—The Timken rod application on a New York Central high-speed streamlined passenger locomotive

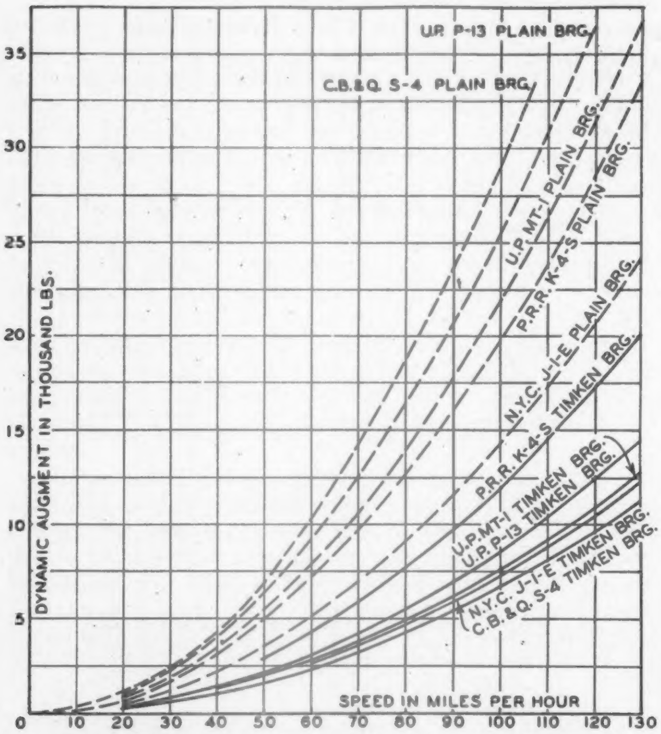

Fig. 2—Reduced dynamic augment obtained by using Timken roller-bearing rotating and reciprocating parts rather than plain-bearing parts

that due to the unbalanced rotating parts just mentioned plus that from the unbalanced reciprocating parts. This maximum force is about 70 lb. for every pound of reciprocating and unbalanced rotating parts. If this force were allowed to become excessive at high speeds, additional strength in locomotive members would be required. Furthermore, these unbalanced weights result in forces producing nosing and fore-and-aft vibrations of the locomotive, although the long and heavy wheel base may tend to reduce the nosing.

The driving wheels on passenger locomotives are large enough to be properly balanced for all rotating weights and an ample percentage of the reciprocating parts. If a small percentage of the reciprocating parts are balanced, to favor a low dynamic augment, then the horizontal forces on the locomotive frame and running gear as well as vibrations from nosing and fore-and-aft movements would be excessive, although the use of the two-axle trailer trucks may improve the nosing condition. Thus, we come to the conclusion that counterbalancing offers no complete solution to the problem since it is merely a compromise between balancing for the vertical and horizontal forces.

Table II—Comparison of Weights of Plain-Bearing and Timken Rods

	Side rods		Main rod	
	Plain bearing	Timken	Plain bearing	Timken
Weight on main pin, lb.	556	338	581	319
Weight on front pin, lb.	190	150	...	...
Weight on rear pin, lb.	176	150	...	...
Weight on crosshead pin, lb.	...	...	422	210
Total, lb.	922	638	1,003	529

This means that higher speeds will require either a reduction in the weight of the reciprocating and rotating parts, or improved and strengthened locomotive and track structure. Obviously, the former is the logical and economical procedure to follow, and such was the basis for the development of the Timken lightweight design. Weight reductions in reciprocating parts of 1,072 lb. per side and up to 52 per cent of the conventional designs have been made as shown in Table I. The very favorable dynamic augment curves for the lightweight application in comparison with those for the heavy design it replaced are given in Fig. 2 for the axles of main driving wheels of locomotives given in Table I. The curves show in general that it is possible by the reduction in weight to increase the diameter speed of steam locomotives by about 35 m.p.h. without change in dynamic augment.

Design of Lightweight Reciprocating Parts

The general arrangement of the application of lightweight revolving and reciprocating parts is shown in Fig. 1. The shapes of all the parts deviate considerably from conventional design and are determined by the proper distribution of metal to give maximum strength with minimum weight so far as this is consistent with good forging and machining practice.[1]

The eye ends of the rods are deep and narrow I-sections which efficiently give considerable rigidity and low bending stresses. This feature is to be contrasted with the usual wide and heavy rectangular section required to obtain the customary low plain-bearing pressures, which contribute to large bending stresses in the column section due to eccentric loading possible over the wide ends, as illustrated by Fig. 3. A comparison of the weights of plain-bearing and Timken rod is given in Table II. The column stresses due to eccentric loading are reduced to a very low value because the narrow width of the rod ends and their simple knuckling action on the outer race of the bearing permit very little eccentricity. This knuckling action takes place on a $\frac{3}{16}$-in.-thick rolled-strip phosphor-bronze bushing pressed into the rod eye and crowned on the surface floating over the outer bearing race. The column portion of the rods is an I-section, and, to carry the column and centrifugal stresses economically it is tapered from a center straight portion to a width of about six-tenths as great at the ends. The usual knuckle-pin joints in side rods and the usual oil and grease holes through the rod eye, which introduce high local stresses and are the cause of many rod failures, have been eliminated. The rear side rod is located in a plane outside the main rod as

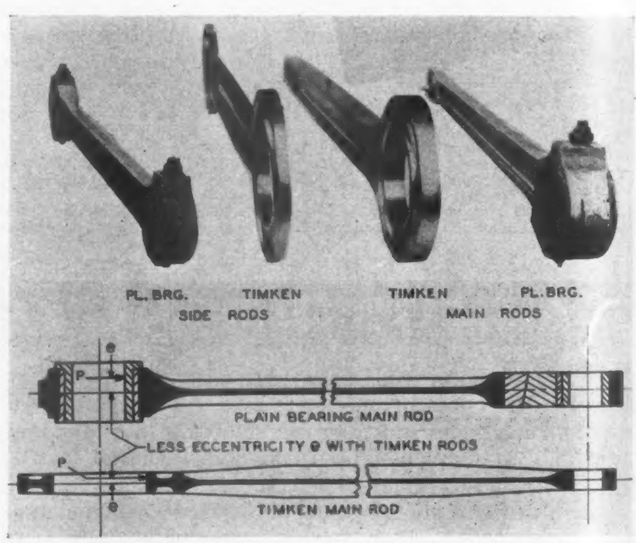

Fig. 3—Comparison of Timken lightweight rod design and decreased eccentricity of loading with plain-bearing rods for a 4-6-4 high-speed passenger locomotive

[1] A complete description of Timken roller-bearing rods was published in the *Railway Mechanical Engineer*, December, 1935, pp. 490-494.

a means of reducing the bending stresses and bearing load on the main crankpin.

The crankpins are made of thin-walled and tapered tubular sections. The crankpin bearings are of the usual Timken tapered design and are fitted directly to the crankpins. The crosshead pin also functions as the inner race of the bearing. The piston rod is a thin-walled tube. The usual massive one-piece cast-steel crosshead is entirely redesigned, eliminating the taper-key connection and using a two-piece construction of thick plates die forged to proper shape.[2] The conical piston is a forged and rolled shape of comparatively thin sections and its extremely low weight permits very successful operation with only two piston rings. The thin plate section of the piston permits deflections several times as great as the usual piston, and this is of value in reducing stresses when water is carried over from the boiler or from condensation in the cylinder. Comparison photographs of reciprocating assemblies for the conventional and Timken lightweight designs are shown in Fig. 4. Table III gives the comparative weights of the two assemblies shown in Fig. 4.

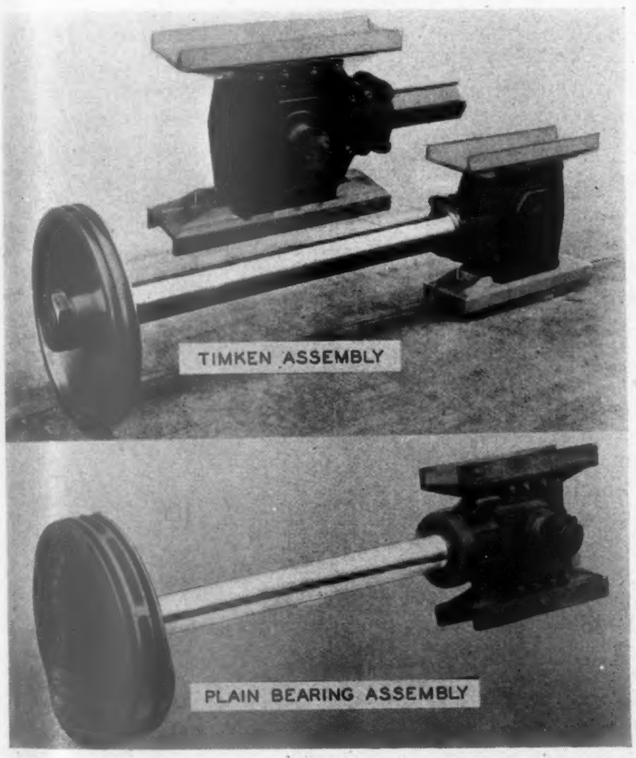

Fig. 4—Comparison of Timken design with conventional design of reciprocating parts for a 4-6-4 high-speed passenger locomotive

Before such service applications could be made on the driving and running gear it was necessary to give considerable study to (*a*) the selection of the proper materials and heat-treatment, (*b*) methods of manufacture, and (*c*) testing to facilitate stress analysis of the various members.

The material selected for the rods, pistons, and principal members constituting the revolving and reciprocating parts is Timken high-dynamic steel of a Cr-Ni-Mo type, having the following nominal chemical analysis: 0.37 per cent C; 0.70 per cent Mn; 0.27 per cent Si; 0.75 per cent Cr; 1.60 per cent Ni; 0.25 per cent Mo. The approximate heat-treatment of all steel parts is a quench in caustic-soda solution or oil at 1,440 deg. F., after which a tempering treatment at 1,200 deg. F. is given. The average physical properties of this steel are shown in Table IV, and for comparison purposes similar properties are given for an aluminum alloy and for plain-carbon-steel forgings in accordance with A.A.R. specifications.

The driving rods, piston, and crosshead are all die forged; the piston rod is made from cold-drawn steel tubing, and the crankpins are hammer forgings. In order to obtain the beneficial effects of grain flow, the development of die shape and forging technique was required. The uniform and maximum strength characteristics obtained by favorable grain flow is indicated by the fact that the maximum and minimum test results of specimens taken from 13 points around the eye of a side rod were: Yield point, 119,500 lb. and 127,500 lb. per sq. in., respectively; ultimate strength, 136,500 lb. and 142,000 lb. per sq. in., respectively; elongation, 19.5 and 22.5 per cent, respectively, and reduction of area, 52.8 and 61 per cent, respectively.

Table III—Comparison of Weights of Timken and Plain-Bearing Reciprocating Parts

Part	Weight of plain-bearing parts, lb.	Weight of Timken steel parts, lb.
Crosshead assembly	754	367
Piston, piston rod, and parts	765	350
Front end of main rod	422	210
Union link and bushing	30	17
Total	1,971	944
Per cent	100	48

Table IV—Average Physical Properties and Strength-Weight Factors of High-Dynamic and Other Steels

Properties	Timken high-dynamic Cr-Ni-Mo	Plain carbon, A.A.R. spec.	Aluminum alloy, 25 ST
Yield point, lb. per sq. in.	115,000	55,000	35,100
Strength-weight ratio	14.70	7.00	12.70
Tensile strength, lb. per sq. in.	132,000	90,000	55,100
Strength-weight ratio	16.80	11.50	19.90
Endurance limit, lb. per sq. in.	62,000	39,000	12,600
Strength-weight ratio	7.90	5.00	4.60
Elongation in 2 in., per cent	22.00	28.00	13.70
Reduction in area, per cent	65.00	50.00	.....
Brinell hardness	285.00	160.00	110.00
Specific gravity	7.85	7.85	2.77

Axle Design

The fatigue strength of axle assemblies, particularly the weakening effect due to the press fit of the wheel on the axle, and the impact forces on axles at high speeds are being studied in full size assemblies by testing them in the locomotive axle testing machine recently installed in the Timken Research Laboratories.

These studies are being made on a testing machine capable of determining the fatigue strength of full-size locomotive axle assemblies 8 ft. long and up to 14 in. in diameter. Axle fatigue failure develops within the wheel fit just inside the inner wheel-hub face. The general nature and the location of the axle failure produced on this machine is comparable to that produced under actual service conditions. However, at the time this paper was written, sufficient data had not been obtained to justify even preliminary conclusions regarding the fatigue strength of full-size axles. A complete description of this axle-testing equipment was published in May, 1937, issue of the *Railway Mechanical Engineer*.

[This concludes Part I of this paper; the second part, devoted to a complete discussion of the factors involved in the design of Timken lightweight reciprocating and revolving parts, will be published in a subsequent issue.—Editor.]

[2] The light-weight Timken crosshead assembly was described in the June 18, 1937, *Railway Age Daily Edition*, page 1004-D101

Determining the

Strength of Riveted Patches*

By J. P. Morrison†

Discussion of the material, workmanship and the design of riveted patches — Some example calculations of typical riveted-patch problems included

RIVETED patches have for many years been recognized as an economical and practical repair of boiler shells and boiler drums containing localized defects. When trouble has been experienced with patches after they have been installed, it has been traceable to the conditions responsible for the original defect; to details of the repair procedure in the preparation of the plates forming the patch seam, such as poor fitting, improper drilling and insufficient scarfing; or to defects in the metal of the shell or patch.

The following discussion of riveted patches deals with material, workmanship, and design, in that order.

Material

Patch material should be fire-box or flange steel, never steel of unknown or inferior quality, and should be of the same thickness as the plate to be repaired. If the original plate is dangerously reduced in thickness because of corrosion, patching should not be attempted, even to continue the boiler in service until new equipment can be obtained, without the approval of persons fully experienced in judging the dependability of such temporary repairs. Boiler shops must be prepared to produce a copy of the steel maker's test reports for all material used in boiler repair work. If it becomes necessary to divide a plate so that a part of it will not bear a "steel maker's brand," an authorized boiler inspector or steel manufacturer's representative should be called to witness the transfer of the brand before the plate is cut.

Rivets, patch bolts, and staybolts must be made of material of good quality.

Workmanship

In each case the distorted sheet should be straightened to the greatest extent its condition will permit, so that the section removed and the patch will be no larger than necessary. A patch should be placed on the inside of the sheet when it is possible to do so, except that if a blow-off connection is included, the patch should be placed on the outside of the sheet. If the part of the shell that needs strengthening is not exposed to the products of combustion nor affected by deposits from the boiler feedwater, it is not necessary, when applying a patch, to remove the defective plate, unless it is greatly distorted.

All rivet holes should be drilled full size or the holes may be punched not to exceed 1/4 in. less than full size for plates over 5/16 in., and 1/8 in. less for plates 5/16 in. or less in thickness, and then reamed to full size with the patch in place. Rivet holes are usually 1/16 in. greater in diameter than the normal diameter of the rivet, but a 1/32 in. difference is preferable when rivets are of uniform size. The foregoing specifications for riveted work are those in the A.S.M.E. Boiler Code, covering new construction.

Rivet holes for patch seams may be countersunk, if desired, but the angle of the chamfer with the longitudinal axis of the hole should not exceed 45 deg. and the depth should be no greater than half the thickness of the plate. The excess strength of the ligaments between the rivet holes over the strength of the rivets, is such that no deduction in the calculated efficiency need be made on account of material removed in countersinking the holes.

Rivets, patch bolts, or staybolts may be used in "riveted" seams in stayed or braced surfaces such as are found in locomotive type and vertical tubular boilers. If staybolts are used in lieu of rivets in a seam, there should be a rivet or a patch bolt between each staybolt and the next adjacent staybolt, and the staybolts should be installed after the riveting or patch-bolting has been completed.

When possible, the edges of a patch should be chipped or planed to the proper bevel for caulking before the patch is fastened to the boiler.

A riveted patch should be tight under a hydrostatic test equivalent to the working pressure before any seal welding is done. In the event that seal welding is applied, the metal should be deposited in a single bead having a throat not less than 3/16 in. nor more than 5/16 in., since contraction stresses resulting from the use of numerous and heavy beads of seal welding contribute to failures. The plate should be at a temperature of at least 60 deg. F when any welding is done. A properly applied patch, however, should not have to be seal welded to secure tightness.

When three or more plates over-lap at a seam, it is necessary to scarf the center plate to a feather edge (a reduction in thickness to 1/32 in. or less) the entire width of the lap. The thickness of the scarfed plate may be reduced to one-half of its normal thickness at the lap rivet hole next to the scarfed edge.

The width of the lap of two plates forming a single-riveted patch seam has been the subject of disagreement. Some designers hold to the rule of three times the diameter of the rivet hole, which applies to longitudinal seams, while others favor a narrower lap, such, for instance, as one meeting the requirements for a girth seam, which is 2.5 times the diameter of the rivet hole. Those ideas are based upon the crushing load, tending to disturb the section of the plate between each rivet hole and the caulking edge or the edge of the inside lap, and take into consideration stresses due to poor operating conditions such as over-heating, rather than the stresses due to pressure alone.

The resistance to heat transfer through two plates forming an excessively wide lap is greater than through plates forming a narrower lap. Accordingly, there is an advantage in using a comparatively narrow lap, that is, one approximately 2.5 times the diameter of the rivet

* From an article published in the July issue of The Locomotive, a publication of The Hartford Steam Boiler Inspection and Insurance Co.
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hole to avoid over-heating the edge of the plate and consequent fire cracks. The over-heating in any case is reduced to a minimum by keeping the inside surfaces clean, but, as a general statement, the original difficulty develops as the result of scale or oil or both, so that the patch is likely to be subjected to the same over-heating as the shell plate.

Seams of patches not exposed to the products of combustion may be similar to the corresponding seams of the boiler, and in most cases should be at least double-riveted.

Design

In "The Locomotive" for July, 1897, and again for July, 1908, there were articles on the design and strength of diagonal joints. The thoughts then expressed were directed toward the use of helical seams in boiler construction, rather than to the design of diagonal seams of patches, but the subjects are so closely allied that in a general way stresses developing in one kind of seam are found in the other.

In patch terminology the "length" of the patch is the dimension parallel to the longitudinal seam and the "width" is that parallel to the girth seam, regardless of which dimension may be the longer.

Experience with patches indicates that, if the maximum length of the patch between rivet center lines (the dimension L as shown in Figures 1, 2 and 3) does not exceed 24 in., it is not necessary to give specific consideration to the strength of the diagonal patch seam, if the proper materials are used, the workmanship is good, and the diameter and spacing of the rivets is normal for the thickness of plate.

When a patch is being designed, it should be kept in mind that the best results are obtainable with crescent, oval, triangular or diamond shaped patches *with a width at least twice the length* and all "corners" well rounded.

Writers have applied various terms to the relation between the efficiencies of circumferential, diagonal and longitudinal seams when comparing one with the other. In the interest of simplicity, reference herein will be made to circumferential efficiency, diagonal efficiency or longitudinal efficiency, when referring to the efficiency of a seam.

In determining the required efficiency of a diagonal seam, it is necessary to know the angle that this seam is to make with a seam of known efficiency. Some writers refer to the angle formed with the girth seam, while others refer to the angle made with the longitudinal seam or with a line parallel thereto. The diagonal efficiency should be based upon the latter angle, because the longitudinal efficiency is of most importance in the calculations made to determine the maximum safe working pressure of the boiler.

The present boiler rules in some jurisdictions use the diameter of the boiler in determining the angularity of a diagonal seam. However, since the angle of a seam depends upon the angle given it when the sheet is laid out "in the flat" and since that angle remains constant regardless of the diameter of the boiler upon which the patch is placed, the diameter of the boiler is not a contributing factor.

In order to simplify the designing of patches and to avoid the necessity for dealing with angles and the trigonometric functions of angles, tables of efficiencies and factors (Tables I and II) have been prepared.

The necessity of designing a patch occurs after weakening or distortion of the boiler shell. The size and shape of the patch are, therefore, predetermined to a large extent by the area of the defect. In addition, the length and width, as herein defined, determine the direction of the patch seam. Accordingly for the practical designing of patches, the plan recommended is based on the relation of the longitudinal dimension L and the circumferential dimension W in the following formula:

$$L/W = K^{\ddagger}$$

thereby eliminating the necessity for measurement or calculation of angles.

The factors upon which the diagonal efficiencies of the seams are based are shown in Table II, Column K, for as many combinations of L and W as are necessary for any desired shape or size of patch. The closest factor should be used if the formula $L/W = K$ gives a factor between two of those given in the table, or, the factor may be determined by interpolation. (See problem 3.)

If a patch is oval or diamond-shaped, it may be con-

Sketch of patches as viewed from outside the boiler or vessel

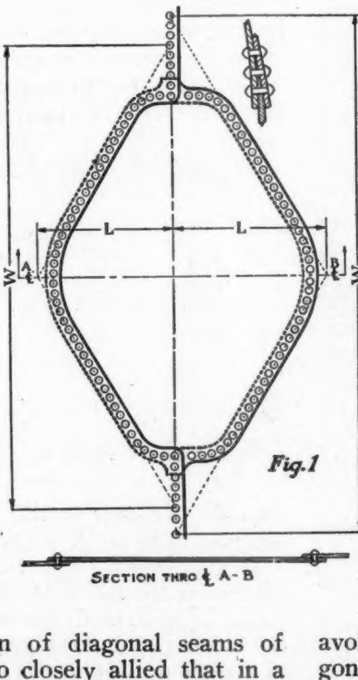


Fig. 1

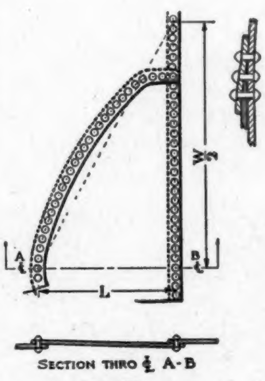


Fig. 2

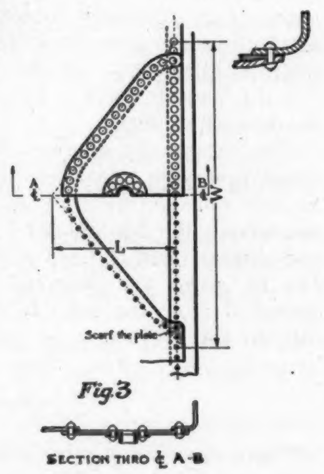


Fig. 3

‡ In the interpretation considered and approved by The National Board of Boiler and Pressure Vessel Inspectors, the formula $W/L = C$ and the angle made by the diagonal seam with the girth seam are used. This method requires different factors for Table II, but the results in solving any problems are the same.

sidered as two patches, using half the longitudinal dimension as L in determining the constant K. Also, if a patch of that description projects in both directions from the girth seam, as illustrated in Fig. 1, L should be measured in each direction from the line of rivet centers of that seam.

Table II, Column F-1 (for vessels in which approximately 75 per cent of the end load is carried by head-to-head braces, tubes or an internal furnace) and F-2 (for vessels in which the heads and shells carry the entire load), give factors representing the relation of the efficiency of the longitudinal seam of a boiler which is to be repaired and the efficiency of the patch seam appearing in column e of Table I. That relation or factor of relative efficiency is found by dividing the boiler-seam efficiency by the patch-seam efficiency thus:

$$F\text{-1 or } F\text{-2} = \frac{\text{longitudinal efficiency of the boiler seam}}{\text{longitudinal efficiency of a seam similar to the patch seam}}$$

The longitudinal efficiency of the boiler seam is calculated in accordance with the A.S.M.E. Boiler Code rules, while the normal or longitudinal efficiency of the patch seam is readily obtained by the use of Table I, using the same plate thickness, diameter of rivet hole and pitch of the rivets for the patch as for a similar seam for the vessel itself. Efficiencies in Table I are for single-riveted seams.

The factors of relative efficiency in Column F-1 are based upon the following formula for F-1, developed to include consideration of those longitudinal forces over and above the load carried by the tubes, through-rods, and similar head-to-head supports. Of course, no credit can be given for diagonal braces, unless such braces extended from the head to the shell in such a way as to support the surface to be patched.

$$F\text{-1} = \frac{1}{\sqrt{\cos^2 a + .015625 \sin^2 a}}$$

The factors of relative efficiency in Column F-2 were calculated from the following formula which applies to diagonal seams of patches to cylinders with unbraced heads, such as a drum of a water-tube boiler.

$$F\text{-2} = \frac{2}{\sqrt{1 + 3 \cos^2 a}}$$

The formulas for determining F-1 and F-2 are given here merely as a matter of information. The use of the tables of factors simplifies the calculations.

The values for the efficiency of the seam given in the fourth column of Table I represent the strength of the rivets in some cases and the strength of the net section of the plate in others, depending upon which is weaker. There may be cases in which the range of combinations of plate thickness, rivet diameter, and rivet pitch, is such that the choice of one rivet diameter results in a weak net section and a high rivet shear, while the choice of a smaller rivet has the opposite result. In such cases it is best to select the larger rivet, because the shearing stress in the rivet of a diagonal seam is relatively greater than the tension stress in the diagonal ligament between the rivet holes.

Given certain of the items necessary for the specifications of a patch, it is possible from Tables I and II to derive the other information necessary, whether for the purpose of designing a satisfactory patch or for checking the strength of a patch already in place. The problems at the end of the article illustrate the procedure to be followed.

The relation between the longitudinal efficiency and the diagonal efficiency of a seam, or the factor representing that relation, depends upon the relation between the girthwise stress seeking to tear the object apart along a horizontal line, and the longitudinal stress seeking to separate the plate or seam in a girthwise direction.

A water-tube boiler having unbraced heads has a girthwise stress twice the longitudinal stress, and accordingly a standard-design girth seam may be said to be twice as efficient as a *similar* longitudinal seam.

A diagonal seam making an angle of 45 deg. with the longitudinal seam and the same angle with the girth seam would have an efficiency 26 per cent greater than the efficiency of a longitudinal seam of the same design, as shown in Table II, F-2 for the factor .500 which is that for the 45-degree angle, made by a patch having a width equal to twice the length.

However, if the tubes and through-rods of a horizontal tubular boiler, for example, are carrying 75 per cent of the longitudinal or end stresses, a diagonal seam forming a 45-deg. angle would have a diagonal efficiency 40 per cent greater than the efficiency of a *similar* longitudinal seam, because the diagonal seam carries no more than 25 per cent of the end load. (See Table II, F-1 opposite .500 for K.)

Table I — Riveted Patches — Seam Efficiency
Single-Riveted Seams

Plate thickness t	Rivet hole diameter d	Pitch of rivets p	Longitudinal efficiency of patch seam e
1/4	11/16	1 7/8	63.3
9/32	3/4	1 7/8	60.
5/16	3/4	1 7/8	60.
11/32	13/16	1 15/16	58.
3/8	13/16	1 15/16	57.
13/32	7/8	2 1/16	57.5
7/16	15/16	2 1/4	56.
15/32	15/16	2 1/8	55.5
1/2	1	2 1/4	52.5
9/16	1 1/16	2 3/8	53.
19/32	1 1/16	2 1/4	52.8
5/8	1 1/16	2 1/4	50.5
21/32	1 1/16	2 5/16	51.4
11/16	1 1/8	2 5/16	51.4

TS 55,000 lb. SS 44,000 lb.

If the length of a patch is to exceed 60 in., consideration should be given to the use of a sheet having a width equivalent to five-eighths of the circumference of the boiler and with longitudinal seams of a design similar to that of the original boiler seams.

When rebuilding the furnace walls after a repair of this kind, dependable means should be provided to protect the new longitudinal seams from the products of combustion.

In designing any patch, three or four rivets on a longitudinal line should not be considered as affecting the diagonal efficiency of the patch seam, because it is almost impossible to secure tightness by caulking a sharp corner, and it often is necessary to have from one to four rivets on a line at right angles to the girth seam in order to round out the circumference of the patch. Figs. 1 to 3 show the characteristic rounded corners necessary for good patch design.

If a patch having diagonal seams is riveted to the shell of a boiler in which the head-to-head braces or tubes or both carry 75 per cent of the end load, and the diagonal seam forms an angle of 60 deg. or more with the longitudinal seam of the boiler (in which case L/W would be less than .288), the strength of the seam may be disregarded, provided the workmanship is satisfactory and the design is normal for the vessel to be patched.

If the diagonal seam forms an angle of 30 deg. or less with the longitudinal seam of the boiler (in which case L/W would be .866 or over), the factor expressing the relation of the strength of that diagonal seam to a longitudinal seam of similar design is so small that the

diagonal efficiency may be disregarded and the strength of the boiler as a whole based upon the efficiency of such a seam considered as a longitudinal joint. When such a repair is contemplated and a material reduction in pressure is not desired, it is recommended that one of three things be done: (1) That a patch be installed having an L/W factor K not more than .500 (for a 45-deg. angle, (2) that a five-eighths ring or a complete ring be substituted, or that (3) a new boiler be installed.

The three figures illustrate how patches of proper design may be correctly installed.

Fig. 1 represents a method of applying a patch to include a part of each sheet adjacent to a girth beam. It will be assumed that there has been serious deterioration as the result of over-heating, bulging, fire cracking and corrosion, so that repairs are needed to both sheets. The use of a single patch, somewhat oval in shape, simplifies the repair, but the scarfing of the patch plate where it is inserted in the old sections of the girth seam requires extreme care. The patch sheet forms the inside lap of the front seam and forms the outside lap of the rear seam. It will be noted that the calculation of the strength of the diagonal or oval seam is based upon L/W considering L as the length of the patch in each direction measured from the center line of rivets of the girth seam. This same sort of a patch may be easily adapted to a location away from any riveted seam by following the principles heretofore outlined.

Table II — Patch Seams
Table of Factors

$L/W=K$	F-1	F-2
.866	1.15	1.11
.832	1.16	1.11
.800	1.17	1.12
.769	1.18	1.13
.741	1.20	1.14
.714	1.21	1.15
.688	1.23	1.16
.663	1.25	1.17
.640	1.26	1.18
.617	1.28	1.19
.596	1.30	1.20
.575	1.32	1.21
.555	1.34	1.22
.536	1.36	1.24
.518	1.38	1.25
.500	1.40	1.26
.482	1.42	1.27
.466	1.45	1.29
.450	1.48	1.31
.434	1.51	1.32
.419	1.54	1.34
.404	1.57	1.35
.390	1.60	1.36
.376	1.64	1.38
.363	1.68	1.40
.350	1.72	1.42
.337	1.76	1.43
.325	1.80	1.45
.312	1.85	1.47
.300	1.90	1.49
.288	1.96	1.51

L = Longitudinal dimension of patch between rivet centers.
W = Circumferential dimension of patch between rivet centers.
F-1 = Factor where 75 per cent of the end load is carried by through braces or tubes.
F-2 = Factor where heads and shells carry entire load.
$K = L/W$; $L = WK$; $W = L/K$.

Fig. 2 shows a crescent-shape patch with the girth seam used as one of the patch seams.

Fig. 3 illustrates a method of patching the rear course of a horizontal tubular boiler where the patch is to include the blowoff connection. It will be noted in this case that it is necessary to scarf the boiler shell plate where the patch, shell plate and head lap at each end of the patch.

Examples of Calculations of Riveted Patches

Problem 1. Design of Patch—A triangular patch is to be placed on the fire sheet of a horizontal return tubular boiler having shell plate $\frac{7}{16}$ in. thick, and longitudinal seam efficiency 74 per cent. The length of the patch is to be 36 in. and a reduction of pressure is to be avoided.

Find the width W of a patch to be applied, using a single-riveted seam of normal design.

Referring to Table I, we find that a $\frac{7}{16}$ in. plate with $\frac{15}{16}$ in. diameter rivet holes and pitch of a $2\frac{1}{4}$ in. gives a seam efficiency of 56 per cent.

The factor of diagonal efficiency is found by dividing the longitudinal efficiency of the boiler seam by the longitudinal efficiency of a seam similar to the patch seam or $.74/.56=1.32$.

From Table 2 in Column F-1, we find a factor of 1.32 requires an L/W constant of .575.

As $L/K=W$, 36 in./.575=62.5 in.

Accordingly, as the length of the patch is 36 in., its girthwise dimension or width must not be less than 62.5 in., if the boiler is to be permitted to carry its present pressure.

Problem 2. Pressure Allowance on an Existing Patch—A horizontal tubular boiler has a patch 30 in. long by 48 in. wide. The patch is of crescent shape and has single-riveted seams.

The boiler shell plate is $\frac{3}{8}$ in. thick, the longitudinal seam is of the double-riveted butt strap type having an efficiency 82 per cent, and the safety valve pressure is 125 lb., but can be reduced to 110 lb. without interfering with the operation of the plant.

What maximum working pressure may be allowed on the boiler, if the single-riveted patch seam has $\frac{13}{16}$ in. diameter holes pitched 1 $\frac{15}{16}$ in. apart, giving a longitudinal efficiency of 57 per cent?

The constant, from which a factor of diagonal efficiency for the single-riveted seam is found, is determined by dividing the length of the patch by the width ($L/W=K$) or 30/48 equals .625.

There is no constant .625 in Column K so the closest constant is selected which is .617 and the corresponding factor in Column F-1 is 1.28.

Since the patch seam would have longitudinal efficiency of 57 per cent and a diagonal factor of 1.28, its diagonal efficiency is $.57 \times 1.28$ which equals .73 or 73 per cent.

The pressure permitted on a boiler varies directly as the seam efficiency. Accordingly, $(.73/.82) \times 125$ equals 111 lb. pressure.

The boiler may be continued in service with the safety valve adjusted to 110 or 111 lb.

Problem 3. Design of a Patch for a Water Tube Boiler Drum—A patch is required for the shell of a longitudinal-drum water-tube boiler. Sections of the plate having a total length of 36 in. (making L 18 in.) are to be removed on each side of a girth seam. The patch will be oval in shape. A reduction in pressure would necessitate replacing the boiler.

The shell plate is $\frac{7}{16}$ in. in thickness with a double-riveted butt-strap longitudinal seam having an efficiency of 82 per cent.

What will be the width of an oval patch?

From Table I we find a single-riveted lap seam in $\frac{7}{16}$ in. plate, $\frac{15}{16}$ in. diameter rivet holes, $2\frac{1}{4}$ in. pitch, has an efficiency of 56 per cent.

The factor of diagonal efficiency is found by dividing the longitudinal efficiency of the boiler seam by the longitudinal efficiency of the single-riveted patch seam; therefore, .82/.56 equals 1.46.

Table 2, Column F-2, has no factor 1.46, but there is a factor 1.45 which corresponds to the constant .325 and there is a factor 1.47 which corresponds to constant .312, so by interpolation, a constant for factor 1.46 would be .318.

As the patch is to be oval, the width of the patch would be $W=L/K$ or 18/.318=56.6 in.

EDITORIALS

Readers as Editors

This particular part of the *Railway Mechanical Engineer* is restricted to comment by editors. But what do our readers think about current problems and tendencies? What difficulties are giving them special concern, and what are they doing to overcome these difficulties?

Without special thought or preparation on our part, the Gleanings page, consisting of high-spot paragraphs from letters in the editor's mail, was started a couple of years ago. These paragraphs, unsigned in order to protect the writers from any possible embarrassment, have met with cordial response by our readers, probably because they express in their own way the thoughts and feelings of their associates performing the actual work out in the field. The Gleanings page long ago passed from its experimental stage and has become one of our features. May we express public appreciation, therefore, to those who unconsciously, in most cases, have assisted in making such a valuable contribution to our columns.

A Turning Point— An Opportunity

Once again, after an interval of several years, the supervisors of the mechanical departments of American railroads will gather in late September for the conventions and joint exhibit of five mechanical associations. To the many hundreds of railroad men who, because of the adverse economic conditions since 1930, have been denied the inspiration of personal contact with fellow-supervisors from other parts of the country these meetings will mark an occasion of outstanding value to them in their work. No one can deny the actual dollars and cents value of an opportunity to "swap" ideas and bring back to his own shop an idea for the solution of a problem that may have troubled a man for many months. So much for the value of association meetings. There is another matter of importance to be considered at this time.

Supervisors who have been connected with these associations in the past have heard a great deal of comment during the depression about proposals for consolidating or even abandoning some of these groups. In all fairness to railroad managements and the officers responsible for policies and expenditures it must be admitted at the outset that as one looks back over the work and conduct of many railroad conventions between 1919 and 1930 it might not be too difficult to discover logical reasons why some railroad officers were beginning to question the worth of these meetings. It is no secret that many mechanical officers were and still are not in favor of sending their men to such meetings and in very few cases is it a matter so much of personal prejudice as of business judgment. Only recently an officer known and respected for his broad vision and the efficiency of his organization remarked that unless certain of the mechanical associations soon recognized the necessity of developing meeting programs of more interest and real technical value their continued existence is a matter of question. These are not particularly pleasing facts but they are none the less important.

As the reports on the preparation of programs for the meetings of the five associations to be held in late September come in it is apparent that the several association officers realize the urgent necessity of presenting material of unquestionable quality in order to build up these organizations again to the positions of prestige and influence they once held. These 1937 meetings may prove to be a turning point in the affairs of some of these associations.

Through the past seven years their activities have been at a low ebb during a time when some of the most radical developments in railroad history have come into being. This very situation offers an exceptional opportunity this year to plan a group of meetings of such absorbing interest and value to the railroads that they will leave no doubt in the minds of the higher officers of the service that can be rendered in the future by encouraging this type of association work.

Sometimes it looks as though many of our railroad supervisors are too close to their everyday jobs to be conscious of the opportunities that lay in their path. Too seldom do they realize that, after all, they constitute, collectively, one of the most important links in the chain of railroad organization. They are the men on whom management must rely to carry out the myriad of details involved in successful and profitable operation. It is for the purpose of providing a melting pot in which the individual ideas of these men may be refined and from which they may be disseminated for the benefit of others that the so-called "minor" associations came into being. All of that vast field of endeavor which may be classified as operation and practice in railroading is the legitimate ground in which these minor associations may work.

It is not the function of these associations to decide policies, effect working agreements between railroads, or set standards for material and design of equipment but rather to plan their activities in such a way as to

bring to light out of the experience of their members the practicability of the methods that must be employed to maintain equipment designed by others under standards and regulations established by others. The success or failure of equipment maintenance depends, to a large extent, upon intelligent supervision.

Any discussion of this subject should not be concluded without mentioning the value of association work to the members as individuals. It provides a medium through which they are bound to broaden their outlook. Through the competition of ideas between equals they learn the value of tolerance, so necessary in the development of true leadership and co-operation with others. The opportunities in association work for the development of self confidence in the exercise of leadership are almost numberless. All through the years among the most prominent railroad officers are those who have labored in the interests of their respective associations. Who are the supervisors of today but the officers of tomorrow?

The value to the railroad of these organizations in the development of men alone is too great to permit them to be permanently discontinued and the responsibility on the part of those guiding their affairs at the present time to see that the programs for this year's meetings command the interest of every supervisor and the respect of every officer is great. If this opportunity is grasped, the place of these associations in the railroad field should be established for years to come.

Railway-Shop Applications Of Cemented-Carbide Tools

The use of cemented-carbide tools in railroad shops, particularly locomotive shops, is rapidly increasing with the realization that these tools can effect production savings on machines employed for a variety of work involving the same as well as different kinds of metals. Although these tools show their best qualities on machines which can be run at high speeds, they can also show distinct savings where the only advantage is the greatly increased length of tool life between grinds. This latter fact is especially true where the tools can be applied to machines the mechanical condition of which is such that extremely high speeds cannot be maintained due to resultant vibration which is detrimental to higher-priced cemented-carbide tools. However, certain speed increases can be made even though such speeds are much lower than those the tools are capable of handling. This again is an advantage inasmuch as the life of the tool is extended beyond that which could be obtained if the machine were run at its maximum speed, thereby increasing further the production per tool between grinds while at the same time it will show a saving from whatever speed increases are possible within the ability of the machine to do the work without vibration.

Every recommended application of cemented-carbide tools should be analyzed carefully. Many of the modern machines are designed with enough power to make the heavy cuts possible with these tools, and the strength of the various machine parts is sufficient to permit high cutting speeds without vibration. However, it may be more desirable, because of the condition of the machine or for shop-production reasons, to increase tool life to a maximum by limiting speeds to a point below those recommended for the tools. For example, on one job where it was possible to run a cut at approximately 300 ft. per min. with a tool life of four hours, it was found possible to extend the tool life to four weeks by reducing the speed to 180 ft. per min. This brings the economic use of these tools well within the scope of railroad-shop practice, contrary to the criticism which has frequently been voiced that the machines are not capable of handling the work at the increased speeds recommended with these tools.

One eastern railroad has been investigating the use of cemented-carbide tools for boring tires. This road has been boring tires with high-speed tools at a roughing speed of 60 surface ft. per minute with a $\frac{3}{32}$-in. feed and a $\frac{1}{16}$-in. to $\frac{1}{4}$-in. cut, and a finishing speed of 66 ft. per minute with a $\frac{1}{16}$-in. feed and a $\frac{1}{16}$-in. cut. It was decided to try cemented-carbide-tipped tools for this job with the result that tires are now being rough bored at approximately 190 surface ft. per min. with a $\frac{1}{16}$-in. feed and a $\frac{1}{16}$-in. to $\frac{1}{4}$-in. cut, and finished at 320 surface ft. per min. with a $\frac{1}{16}$-in. feed and a $\frac{1}{16}$-in. cut. The economies effected are at once apparent.

If these tools are to be used to the best advantage, special training of operators is necessary. The tools must be carefully ground and honed to obtain the best results. Speeds and feeds must be carefully studied for each material. Generally speaking, lighter cuts, lighter feeds and higher speeds must be used for the best results. When cemented-carbide tools are introduced into a shop, it is advisable to adhere strictly to practices recommended by the tool manufacturer and to train at least one man thoroughly in their use. The machining features of cemented-carbide tools are so radically different from those of high-speed tools that many old ideas regarding machining practice should be forgotten.

Locomotive Inspection Then and Now

In a striking analysis of the results of 25 years of federal locomotive inspection, presented at the March meeting of the Southern & Southwestern Railway Club, John M. Hall, chief inspector, Bureau of Locomotive Inspection, I.C.C., brought out a number of facts which are well worth reviewing for the benefit of readers of *Railway Mechanical Engineer.* According to Mr. Hall,

early proposals for federal locomotive inspection were strenuously resisted, step by step, by many railroads and railroad men who failed to get a clear picture either of the necessity for federal inspection or the benefits which would result. The Bureau was successful in changing this sentiment over a period of years and now, with practically unanimous railroad support, has an enviable record of achievement to its credit, not only in accident prevention, but in promoting a substantially higher standard of locomotive maintenance and performance, with resultant favorable effect on railway earnings.

Reverting for a moment to the past, locomotives built three decades ago were equipped largely with ash pans which had to be cleaned from underneath, with attendant hazards resulting in the death and injury of many employees. The first government regulation, adopted after considerable agitation and strong railroad opposition, was the Ash Pan Act, passed by Congress May 30, 1908, and requiring the installation of ash pans which could be dumped, emptied and cleaned without the necessity of employees going under the locomotives. The practicability and effectiveness of the new law was quickly demonstrated by the complete elimination of this particular type of casualty.

Similarly, frequent explosions and other accidents due to the use of defective boilers and appurtenances resulted in casualties which created a demand for federal regulation of boiler conditions, and the Boiler Inspection Act was eventually passed by Congress and made effective July 1, 1911, establishing a Bureau charged with the responsibility of seeing that the railroads maintained locomotive boilers and appurtenances in proper condition and safe to operate. This act produced the desired results, but, with the concentration of attention on ash pans and boilers, certain other important parts of locomotives, such as the running gear and machinery, were more or less neglected, and consequently the Boiler Inspection Act was amended March 4, 1915, to extend the jurisdiction of the Bureau over the entire steam locomotive and tender, this amended act being generally referred to as the Locomotive Inspection Act. Still one further extension of authority was granted on June 7, 1924, when the jurisdiction of the Bureau was extended to include locomotives propelled by power other than steam.

The results of the Locomotive Inspection Act, as amended and enforced in the intervening years since its first passage, are well known and a matter of public record. Mr. Hall credits the act with preventing 1,622 deaths and 14,695 injuries, or a reduction of 64.7 per cent in the number of deaths and a reduction of 48.9 per cent in the number of injuries that would have occurred if casualties had continued at the same rate as in the first year the act and the amendments were effective. He says that these estimates, moreover, do not take into consideration the large, but indeterminate, reduction in killed and injured, caused by the practical elimination of steam leaks which obscure the view of enginemen.

Mr. Hall closed his paper with the following pertinent comments: "As I have tried to show in my paper, while there was considerable antagonism and lack of co-operation in the earlier days, that antagonism has largely disappeared and we now have the sincere co-operation of the railroads. They are working with us in an endeavor to maintain locomotives in such condition as to prevent accidents. I believe I am also safe in saying that we now have the sincere co-operation of practically every mechanical officer in the United States.

"I am also convinced that the managements of the railroads have come to realize that instead of the Bureau being a hindrance, inspection by the federal government is really helping them not only to operate safer equipment, but keep locomotives in better condition, which means economy in operation, fewer failures and fewer accidents, and, at the same time, conservation of life and limb, thus making the railroads the safest means of transportation from one end of the U. S. A. to the other."

New Books

UNITED STATES REGULATIONS FOR STEAM AND OTHER THAN STEAM LOCOMOTIVES. *Published by Gibson, Pribble & Co., Richmond, Va. 218 pages, 6½ in. by 4 in. Price, $1.25.*

Four government booklets, completely indexed as one, are brought together in this book. They are the Laws, Rules, and Instructions for Inspection and Testing of Steam Locomotives and Tenders; those for Other than Steam Locomotives; Interpretations, Rulings and Explanations on Questions Raised relative thereto, as prescribed by The Interstate Commerce Commission, Bureau of Locomotive Inspection, and Safety Appliance Standards for Locomotives as Fixed by Order of The Commission, dated March 13, 1911.

VANADIUM STEELS AND IRONS. *Published by the Vanadium Corporation of America, 420 Lexington avenue, New York. 189 pages, illustrated. Bound in flexible leatherette. Price, $1.25.*

Vanadium Steels and Irons is a review and reference source for the chemical composition, physical properties, heat treatment, recommended applications and fabricating procedure of all irons and steels in which vanadium is an alloying element. Structural steels for light and heavy sections, S. A. E. alloy and related high-test steels, spring steels, cast steels, tool steels and nitriding steels are treated comprehensively, with complete data on physical properties and heat treatment. In each case conditions under which most favorable service results can be expected are specifically outlined and suggestions made for correlating the choice of alloy steel and its heat treatment with the fabricating procedure to be used. Charts and tables are based on the latest authentic tests and analyses. Bibliographic references under each chapter head include a great deal of new work, and a special chapter is devoted to a consideration of high-test alloy cast irons.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Management Employee Relationships

A higher standard of living does not mean a more contented people. Quite the reverse. In fact, discontentment is the driving force that creates desires beyond bare necessities. Therein lies the answer to the apparent contradiction between present labor unrest and the highest standard of living the world has ever known. Wise executives recognizing this will give the full measure of attention that employee relationships need.

Valve Repairs and Adjustments

The article about valve repairs and adjusting, as developed in the West Albany shops, in your April issue, is the most practical discussion on the matter I have ever read, and should be worth many dollars to the shop official who takes advantage of the information given. There is only one defect that could exist after an overhaul of the valves and valve motion, as described, and that would be in the steam passages of the cylinder casting. I made an unsuccessful attempt to interest a general foreman in a somewhat similar system as far back as 1911, but the art of welding was not far advanced then, and the shop was really too small to handle the methods to advantage.

Pensions?

What is happening in Washington about the payment of railroad pensions? According to all reports, the railroads and the labor unions came to an agreement on this question and we understood, also, that adequate legislation had been enacted to set the machinery for the new pension system in motion. Some of our men who have applied for pensions say they have not even received an acknowledgment, although several weeks have elapsed since they presented their claims; others who filed applications many months ago under the provisions of the 1935 act are harsh in their criticisms over delay in handling their cases. Presumably it will take much time and patience to set up the elaborate and extensive organization which will be required for handling railroad pensions; on the other hand, when the 1935 pension act, which has now been superseded, was adopted, an organization was set up which, up to the end of 1936, made about 2,100 annuity grants. What is holding up things now?

Responsibility for Excessive Slack

You have discussed in your columns the handling of passenger trains, but the writer does not recall seeing anything bordering on a frank discussion of the responsibilities of the car department for excessive slack in passenger-car couplers and draft attachments. You know the effect of this sort of thing on the comfort of passengers—and you know, too, that these remarks are not aimed at any one railroad, because you travel around a bit and have your rest disturbed the same as the rest of us; so why not shake up the car maintenance forces in your column? Oh yes, we all know that the car designers have concealed the draft gear so neatly that nothing short of X-rays can inspect it unless it is taken down. But why not feelers, peep holes, gages, or something else worthy of the intelligence and ingenuity of the car foreman? And don't tell us that the transportation people won't cut the cars to the shop track. They cut 'em out when a wheel is condemned. And are draft gears always given the attention they require when the car is actually on the shop track for other work?

Condensation in Box Cars

What is the latest word about the prevention of condensation in box cars? Here is an old, old problem that we don't seem to make much progress in solving, in spite of the great amount of damage that is being done to certain types of lading. Not only do the railroads have to pay the claims, but the irritation caused to the shippers does not help at all to make them more friendly to the railroads. I know that many schemes and devices have been tried out, but in our own experience there is still too much of such condensation. According to the statement made by W. L. Ennis, manager of refrigeration service and claim prevention of the Chicago, Milwaukee, St. Paul & Pacific Railroad, at a meeting of the Car Foremen's Association of Chicago last year, "this class of damage is increasing. It is very bothersome, because it is difficult to arrive at the measure of damage."

The Boiler Department Problem

The outstanding need in the successful operation of the boiler department today is not tools, equipment or machinery; it is men, or rather young men—apprentices who are sufficiently interested to be developed in the fine arts of the trade. With improved methods and tools making for easy ways of doing what used to be hard work, our younger men have lapsed into a lethargic state of thinking that anything that requires real work is unnecessary. The question is asked daily in every shop where construction work is done: "Who is going to take the lay-out job when the present lay-out man quits, or is pensioned—who is going to be the next flanger, boiler inspector, assistant boiler foreman and general boiler foreman?" There are many wishers who would be glad to take any of these jobs, but where is the young man who will apply himself studiously, long enough to qualify even to start on any of the jobs listed?

Boiler making is still a man's job, if taken seriously, and requires much more ability than the operation of a torch or an electric arc. Within the next ten years nearly all of the present supervisory forces will have passed on, in one way or another, and the serious problem will be to replace these seasoned men, who have spent all their working life at the trade. Let's not try to laugh this off, as we all want to turn over our stewardship to experienced men who will be able to carry on in a creditable manner. The opportunities are great at this time for younger men who aspire to become all-around boiler makers, lead men and foremen, but to get this message over seriously seems almost an impossibility.

Most all of our young men want to cut or weld, or do something easy—they want to make it in one jump. The long, tedious trail does not enchant the younger set today, but the detail work necessary to the successful development of real mechanics has not changed a great deal. There is no short cut to knowledge; experience is still the teacher, and if we can really impress this on our apprentices now we will have started in the meeting of a future great need for the boiler department, in which we have taken such pride and have made our life's work. Boiler department apprentices and younger boiler makers, please answer this question: "Who will fill the Old Man's shoes ten years from now; will you prepare yourself to be one of them?" The above is written not by an old man, but by a boiler maker who learned the trade by hard work and has spent 40 years at it, from heating rivets to filling the Old Man's shoes.

IN THE BACK SHOP AND ENGINEHOUSE

Quantity Production of Piston-Valve Packing Rings

The "L" type packing ring shown in Fig. 1 is used generally for locomotive piston valves on the New York Central and the production of these rings has been concentrated as shown above, at the West Albany shops of the railroad. Fig. 1 shows a detailed description of the ring which is made in various sizes for valves from 10 in. up to 16 in. diameter, and in step sizes beginning with the nominal diameter of steam-chest bushings and increasing in step sizes of $\frac{3}{32}$ in. until the maximum diameter of $\frac{3}{8}$ in. over nominal is reached when the bushings are replaced with new ones having the nominal diameter. This system of step sizes has been developed after exhaustive study as to the amount of enlargement necessary to rebore valve bushings to overcome wear

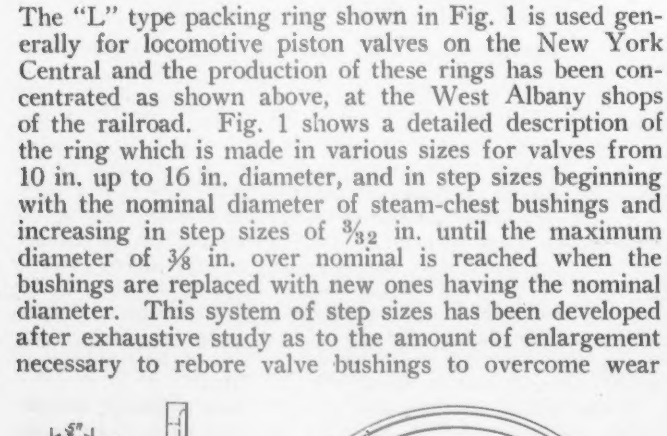


Fig. 1—The two styles of valve rings used on the New York Central System

and the increased sizes are above nominal diameters as follows: $\frac{3}{32}$ in., $\frac{3}{16}$ in., $\frac{9}{32}$ in. and $\frac{3}{8}$ in.; at the latter size the bushings are renewed after nominal service.

The packing rings are made of gun iron or its equivalent, which is furnished in castings or ring blanks of a height sufficient to produce 18 finished rings. The casting has a 45 deg. beveled chucking collar, as shown in Fig. 2, and also as the second operation in Fig. 4, which provides excellent chucking facilities since it tends to

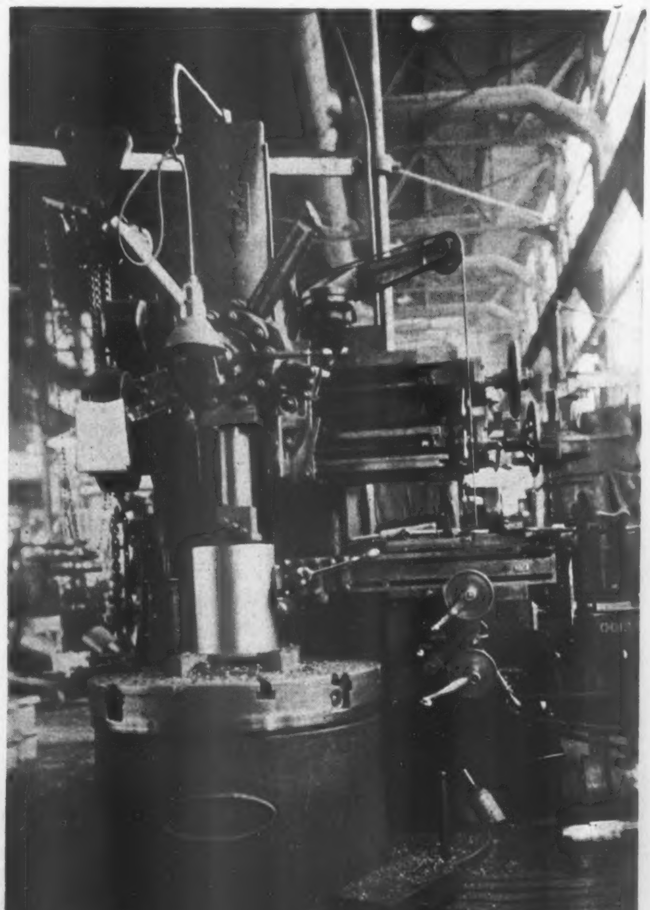


Fig. 2—Vertical turret lathe finish turning the valve-ring pot

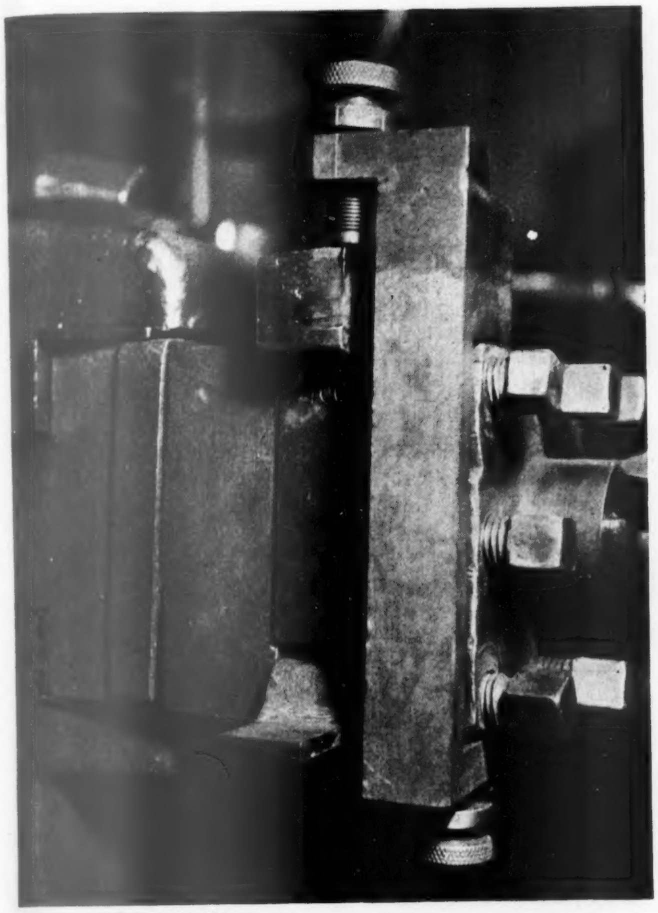


Fig. 3—The gage used to set up the finishing tool—After the cutting edge of the tool is set against the face of the adjusting screw shown at the top and the tool is tightened in that position, all finish cuts are made with the micrometer dial on the side head rather than by calipers —Note scribe marks line-in-line on the adjusting screw and body

hold the casting securely in place while machining and also wedges the casting down on parallels provided on the inner end of special chuck jaws made for this operation.

The rings are turned, bored, faced, recessed and parted from the casting on a 42-in. vertical turret lathe after which they are ground on the flat side to a snap-gage size on a 30-in. motor-driven rotary grinder. The ring is then drilled for dowel clearance, sawed and expanded on a finishing bench.

Method of Production

The ring blank is placed on the vertical turret lathe and chucked, using a special self-centering device. The first machining operation is to face the top of the casting, using a Stellite-tipped facing tool. Then the casting is rough turned and rough bored, as shown in the first operation in Fig. 4, at a surface speed of approximately 80 ft. per min. and a feed of 0.068 in. per revolution, using Stellite-tipped tools for both operations. Sufficient stock is left for a finish cut on the inside and outside of the casting. The outside finishing cuts are made with Stellite-tipped tools at a surface speed of 80 ft. per min. and a feed of 0.083 in. per revolution. The outside of the ring is turned $\frac{1}{32}$ in. + 0.006 in. oversize and bored $\frac{3}{64}$ in. oversize. The reason for boring $\frac{3}{64}$ in., or $\frac{1}{64}$ in. above the $\frac{1}{32}$ in. oversize, is to insure clearance for the division ring, valve body and follower in the event it is necessary to file the joint in fitting the ring to the valve bushing. This method also produces a ring of equal cross-sectional area throughout its entire circumferencial length.

The rough and finishing tools in the side head of the machine are set up with the gage shown in Fig. 3, which gage enables the operator to set the tool in the side head always in the same position with respect to the zero reading on the side-head micrometer dial. With the tool always in the same position in the side head, the operator is able to obtain sizes without the use of calipers, the size being taken from the micrometer dial on the side head. The gage for adjusting the outside finishing tool is originally set in the following manner: A bushing is placed in the machine and turned to a micrometer size of 6 in., after which the tool is placed in the side head and clamped against the work with the micrometer dial on the side head set at zero. The adjustable screw on top of the gage shown in Fig. 3 is then set against the cutting edge of the tool. From then on the tool is always replaced in the side head with the cutting edge against the screw adjustment of the gage, thus locating the cutting edge of the tool always in the same position with respect to the side-head mi-

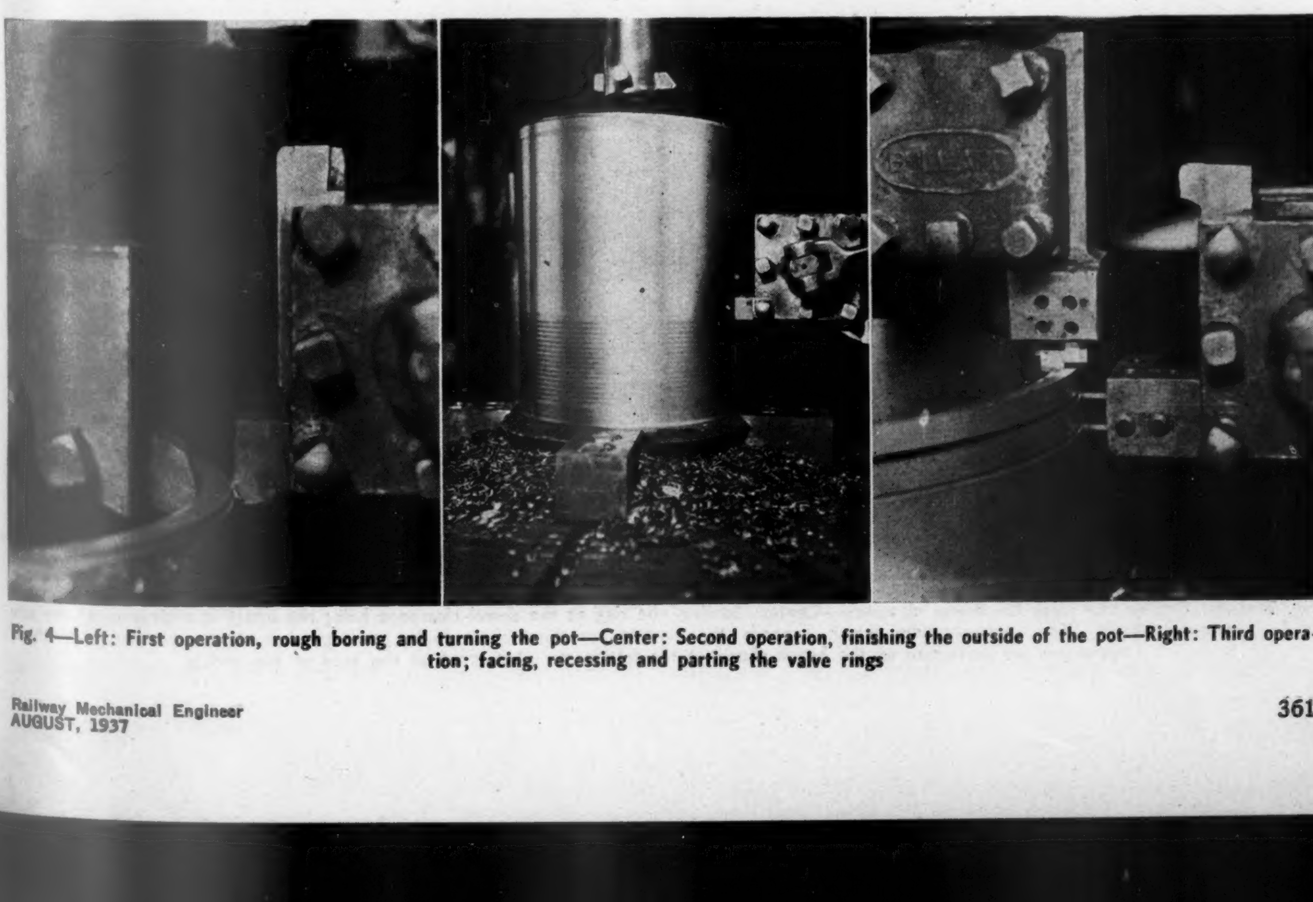


Fig. 4—Left: First operation, rough boring and turning the pot—Center: Second operation, finishing the outside of the pot—Right: Third operation; facing, recessing and parting the valve rings

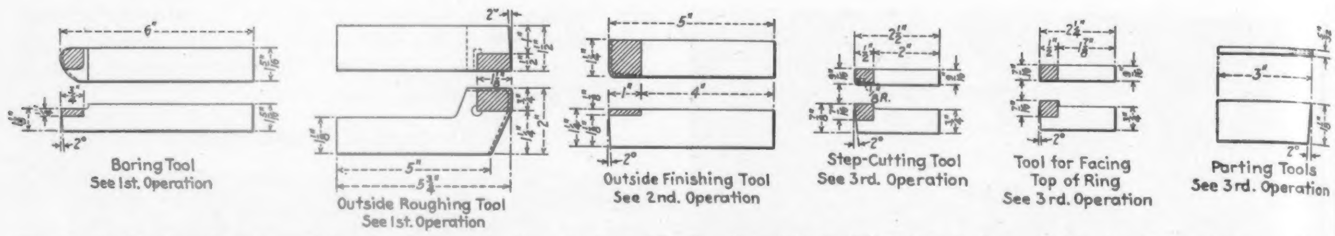


Fig. 5—Stellite-tipped tools used in valve-ring production at West Albany—From left to right these tools are the boring tool, outside roughing tool, outside finishing tool, step-cutting or recessing tool, facing tool, and all-stellite parting tool. The operations refer to Fig. 4

crometer dial set at zero. Finish sizes above or below 6 in. are then made directly by the micrometer dial rather than by the use of calipers.

After the finishing operations are completed the ring is recessed and faced on top using the set up of recessing and facing tools held in a gang holder placed in one of the tool holders in the turret on the main head as shown in the third operation in Fig. 4. While recessing and facing is being performed with the main head, the ring is parted from the casting, as also shown in the third operation in Fig. 4, with a gang of two $\frac{5}{32}$-in. Stellite parting tools held in a special gang-tool holder placed in the turret tool holder on the side head, one tool being set $\frac{3}{8}$ in. ahead of the other one to part one ring while the other tool is grooving the casting for the next parting operation. The surface speed of these operations is approximately 64 ft. per min. using a feed of 0.011 in. per revolution. The tools used in all the operations are shown in Fig. 5.

After the ring is parted from the casting, a serial number, 1, 2, 3, 4 or 5, depending on the size of the ring, is stencilled on the finished face of the ring to indicate the size. These serial numbers are used in place of ring sizes in order to eliminate excessive stencilling; No. 1 indicates a ring of nominal diameter; No. 2 indicates a ring $\frac{3}{32}$ in. above nominal; No. 3 indicates a ring $\frac{3}{16}$ in. above nominal; No. 4 indicates a ring $\frac{9}{32}$ in. above nominal and No. 5 indicates a ring $\frac{3}{8}$ in. above nominal diameter.

Fig. 6—The rotary surface grinder used for grinding the plain side of the rings to snap-gage dimensions

Fig. 7—Left: Drilling the rings for dowel clearance—Center: Sawing the ring at the dowel-clearance hole; the insert is a close-up of the saw blade and guard—Right: The ring expander which expands the ring to approximately a $\frac{3}{8}$-in. opening when at rest position. All these operations are performed on the bench shown at the left in the photograph at the head of this article

Three rings are then placed in one setting on a 30-in. rotary surface grinder, which is shown in Fig. 6 and ground on the plain side to snap-gage dimensions, using a soda-ash coolant, after which it is dipped in a tank of soda-ash solution to wash off all grindings and protect it from rust and corrosion. A ½-in. hole is then drilled in the ring for dowel clearance, using the electric bench drill and the pneumatically clamped drilling jig shown as the first operation in Fig. 7. The clamp is foot-operated from the floor. After drilling, the ring is sawed through the center of the ½-in. dowel-clearance hole with the ⅛-in. saw shown as the second operation in Fig. 7, which sawing leaves ⅜ in. for clearance over the $^5/_{16}$-in. dowel in the division ring in the valve assembly. The saw feed is actuated by a foot lever while the operator holds the ring in the sawing jig.

As noted previously in this article, the rings are turned $^1/_{32}$ in. or 0.03125 in. oversize in diameter, which produces an oversize of 0.098 in. in circumference. The ⅛-in. saw cut leaves a clearance between the ends of the rings of approximately 0.027 in. when applied to a valve bushing with no plus or minus variation from nominal size. Specifications call for an opening of from $^1/_{64}$ in. to $^1/_{32}$ in. between ends of the ring when in position in the valve chamber. To produce this result the ring, after being sawed, is expanded in the expanding device, shown as the third operation in Fig. 7, which is operated on the cam principle. This provides a snap action which expands the ring to an opening of 2 in. in the cut and gives the ring an opening of approximately ⅜ in. when at rest position. This produces a tension in the ring which requires a pressure of approximately 60 lb. to close the ring opening when pressure is applied at points 90 deg. each side of the opening.

With the facilities heretofore mentioned it is possible to produce approximately 80 rings per eight hours on one machine. The rings are then placed in stock in the stores department from where they are distributed to all points on the entire system.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Shearing Strength of Welded Joints

Q.—Will you kindly give me an illustration on how to figure the shearing strength of a welded joint, especially spot and intermittent girth and head welds.—F. K. M.

A.—The strength of a welded joint depends largely upon the quality of the weld and the ability of the welder. The strength of a welded joint cannot be computed as in the case of a riveted joint. Therefore it must be based on actual tests.

A series of shear tests for welds made by Andrew Vogel, General Electric Company, Schenectady, N. Y., are summarized as follows:

A series of twelve specimens were made in accordance with recommended practice of the Committee of Standard Tests for Welds (American Welding Society). The series was divided into four groups of three specimens each, four welders of average ability were selected and each welder was directed to weld a group of three specimens. No special instructions were given, in order that the welds should indicate the average ability of each welder.

The tests were made in the usual manner and the results are recorded in the table below:

Specimen	Total Stress	Stress per linear inch of weld	Average stress	General average stress
A-1	75,750	12,625		
A-2	81,300	13,550	13,217	.....
A-3	80,850	13,475		
B-1	81,400	13,567		
B-2	72,600	12,100	12,947	.....
B-3	79,050	13,175		
				13,252
C-1	88,050	14,675		
C-2	80,600	13,433	14,314	.....
C-3	89,000	14,833		
D-1	76,750	12,792		
D-2	76,700	12,783	12,536	.....
D-3	72,200	12,033		

It will be observed that the total load varies from 72,200 to 89,000 or from 12,000 to 14,000 lb. per linear inch. The welds were of average quality such as commonly used, and as a design value of 3,000 lb. per linear inch for ⅜-inch weld is used, the result is a factor of safety of four or more.

Shielded-Arc and Arc Welding

Q.—What is shielded-arc welding and how does it differ from arc welding?

A.—Shielded-arc welding differs from arc welding in that a shielded arc is obtained through the use of specific types of electrodes which are heavily coated. The heavy coat is of such composition that in the heat of the arc it gives off large quantities of gas which envelops and completely shields the arc from the ambient atmosphere.

The electrode coating is consumed in the arc at a slower rate than the rate of deposition of the electrode metal. As a result of this the coating extends beyond the metal core of the electrode and serves to direct and concentrate the arc stream.

The action of the arc on the coating of the electrode results in a slag formation which floats on top of the molten weld metal and protects it from the ambient atmosphere while cooling. After the weld metal is sufficiently cooled the slag may be easily removed.

It is common knowledge that molten steel has an affinity for oxygen and nitrogen. When exposed to the air molten steel enters into chemical combination with the oxygen and nitrogen of the air to form oxides and nitrides in the steel. These impurities in the steel tend to weaken and embrittle it as well as lessen its resistance to corrosion.

In the ordinary arc the molten globules which pass from the electrode to the work are exposed to the ambient atmosphere which contains chiefly oxygen and nitrogen. The molten base metal is also exposed to these elements. They combine with the molten metal forming oxides and nitrides in the weld metal. If the metal during the fusion process is completely protected from contact with the ambient atmosphere the injurious chemical combination cannot take place. This can be achieved by completely shielding the arc.

An arc may be shielded by completely enveloping it with an inert gas, which will not enter into chemical combination with the molten metal and at the same time prevent its contact with the atmospheric oxygen and nitrogen. Welds made with a completely shielded arc

are largely free of oxides and nitrides and are therefore composed of metal having superior physical characteristics to that deposited by an ordinary arc. For example, welds made with a shielded arc have a tensile strength of 60,000 to 80,000 lb. per square inch which is 20 per cent to 50 per cent higher tensile strength than that possessed by welds deposited by an ordinary arc. The ductility of welds made with a shielded arc averages 100 per cent to 200 per cent greater. The resistance to corrosion of shielded arc welds is greater than even mild rolled steel and far greater than that of welds made with an unshielded arc.

The Life of Boiler Tubes

Q.—How is the life of a locomotive boiler tube usually determined?—M. T.

A.—The Interstate Commerce Commission Bureau of Locomotive Inspection, Laws, Rules and Instructions for inspection and testing of steam locomotives and tenders and their appurtenances, Rule 10, states, in part:

Flues to be removed—All flues of locomotive boilers in service, except otherwise provided, shall be removed at least once every four years, and a thorough examination shall be made of the entire interior of the boiler. After flues are taken out the inside of the boiler must have the scale removed and be thoroughly cleaned. This period for the removal of flues may be extended upon application if an investigation shows that conditions warrant it.

When tubes are removed from the boiler they should be examined for surface defects and so far as possible shall be free from depressions caused by scale or scoring.

The tubes deteriorate more rapidly at the ends toward the fire, and they should be carefully tapped with a light hammer on their outer surface to ascertain whether there has been a serious reduction in thickness. The condemning limit of tubes is usually determined by weight. This weight varies somewhat at the different shops, the weights given below being an average.

Tubes and flues are to be weighed and those meeting weight, shown in the following table, are to be welded and used on any locomotive:

Outer Diam. In.	Nearest B.W.G.	Decimal Thickness B.W.G.-In.	Minimum Weight Lb. per Ft.
1¾	12	0.109	1.57
1¾	11	0.120	1.57
2	12	0.109	2.05
2	11	0.120	2.05
2¼	12	0.109	2.31
2¼	11	0.120	2.31
2½	12	0.109	2.56
2½	11	0.120	2.56
3¼	11	0.120	3.56
3¼	10	0.134	3.56
3½	12	0.109	3.66
3½	11	0.120	3.66
5⅜	9	0.148	7.51
5½	9	0.148	7.75

Protecting Tubes Against High Temperatures

Q.—What practical steps may be taken to enable boiler and superheater tubes to withstand higher temperatures?—C. C.

A.—There are various possibilities. One is the use of tubes made of special alloy steel, usually containing some chromium, which is heat resistant and has less creep than the ordinary steels. Such special tubes will withstand higher temperatures with less loss of strength and tendency to blister. Another is coating the outside of fire tubes with aluminum (calorizing). This thin coating appears to give some protection of the metal against high furnace temperature. It has been used on tubes of mercury boilers and is employed sometimes on superheater and fire tubes. The most obvious thing, however, is to maintain the water or steam surface clean and absolutely clear of all deposits. This is secured by having a smooth interior surface and by suitable chemical treatment of the boiler water.

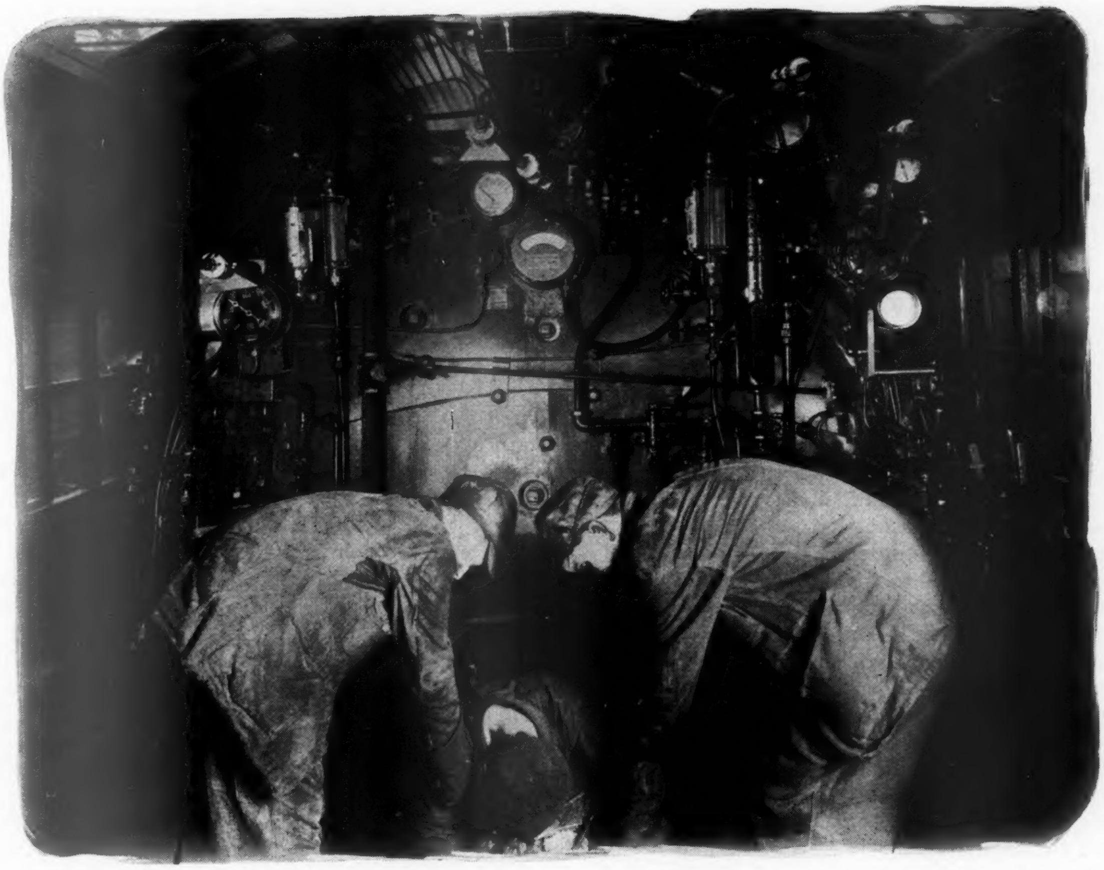
Jig for Boring Truck Brasses

A well-made chuck, or jig, for holding engine-truck brasses while being bored in an engine lathe, is shown in the illustration. This lathe chuck attachment, now being used at the Chicago & Eastern Illinois shops, Danville, Ill., consists of two accurately finished, hardened-steel, angle brackets, which slide on the cross-carriage V-ways, and are connected to the cross-feed screw by right and left nuts, which make the brackets self-centering with respect to the lathe-spindle center line.

The engine-truck brass rests on a steel plate of the proper thickness to leave a maximum amount of bearing metal permissible at the crown. A turn of the cross-feed screw quickly centers the brass and holds it firmly during the boring operation, two angle set screws in each bracket being provided as an extra precaution against the brass working loose in the jig during the boring operation which is performed by a stationary boring-bar cutter, set to the proper radius and revolved while the longitudinal feed of the lathe carriage is engaged.

The rather neat galvanized-iron chip guard, applied over the cross-feed screw and attached to the nearer angle bracket so as to move with it, is clearly shown in the illustration. The chip guard at the back of the engine lathe also is of an unusually neat and satisfactory design. It is estimated that the use of this special chuck, or jig, effects a saving of at least 15 per cent in the cost of boring engine-truck brasses as compared with the method formerly used.

Engine lathe equipped with special chuck or jig for boring truck brasses



The fire builder and the boilermaker helper dragged Barton out of the firebox

HOT WORK

By

Walt Wyre

It's the private opinion, often publicly expressed by members of other crafts in railroad roundhouses, that boiler makers are more or less a necessary nuisance and not so very necessary. The idea started when electric welders did away with the use of bran, sawdust, horse manure, and other panaceas for leaky flues. At that, engines with leaky flues were the rule rather than the exception, and a locomotive without a few plugged flues was almost unheard of.

In those days a favorite theme of fiction writers was about the heroic fireman that crawled in a hot fire-box to stop a leaky flue with a plug cut from a green sapling along the right of way and thereby got the train over the road in time to save the mail contract for dear old wooden axles. Incidentally, the beautiful daughter of the superintendent, or maybe it was the president's, was always handy at the end of the run to pillow the fainting fireman's head in her lap and soothe his blistered brow with kisses so hot they drew the fever out of the burns.

It took a lot of boilermakers to keep the leaky kettles calked so they would make a run over a division without putting the fire out. In many instances boilermakers outnumbered machinists. Good boilermakers were in demand and ones that wanted to work seldom out of a job.

It's different now. Leaky flues are as rare as sweat from a relief worker's brow and a fireman would let a locomotive on the president's special die dead as the League of Nations before he would crawl in a fire-box unless the fire-box was air conditioned.

But because steam failures are infrequent and there are not so many boilermakers, members of other crafts have gotten the idea that about all boilermakers are good for is to make a lot of noise and keep the acetylene torches tied up all of the time.

Boilermakers may not be as numerous as before, but they are just as necessary for the operation of locomotives and they're doing a better job. True, electric welders and treated water have reduced the amount of boiler work required, but higher steam pressures, longer runs, and more rigid requirements by the I.C.C. make better work necessary. No longer is any job that will hold water in a boiler considered good enough. That's only the first consideration. It must be done according to exact specifications. That's the rule, and it's seldom violated. Only on occasional exceptions in an emergency a boilermaker may do a job not according to standards. Sometimes such jobs get by; more often than not, they don't; then somebody gets all torn up like a sow's bed.

Jess Horton, a boilermaker for the S. P. & W. in the

roundhouse at Plainville, was making a monthly inspection and test on the 5091. Jim Evans, the roundhouse foreman, was walking circles around the locomotive wanting to know when he could take a call on it. The instant the last washout plug was tightened and the fill-up hose connected, Evans beat it to the roundhouse and called the dispatcher.

"It'll be the 5091 on the second fruit train," the foreman said.

"O.K.," the dispatcher replied. "I was just wondering if you were going to have an engine. It'll be at 4:30."

"Wow!" Evans exploded. "Can't you give us a little more time on her? It's almost three o'clock now and no fire in the engine yet."

"Well, make it five o'clock, and that means leaving at five," the dispatcher said.

Evans hung up the receiver and rushed back to the roundhouse. "Get a fire going in the 5091 the minute she shows a gage of water and crowd her all you can," the foreman told the firebuilder.

At 3:45 Evans climbed in the cab to see how the 5091 was coming along. The gage showed twenty-five pounds of steam and the oil burner was going good. Pressure would climb rapidly from then on. He gave a sigh of relief, bit a corner off a plug of "horseshoe" and climbed down from the cab. After a turn through the house, he went back to the office.

At 4:10 Horton burst into the office like an overdue accident looking for a place to happen. "The 5091—it's got a washout plug leaking!" the boilermaker panted.

"What!" Evans snapped. The front legs of his tilted chair hit the floor with a bang.

"Yeah," Horton replied dolefully, "it's leaking pretty bad."

"Can't you tighten it?" the foreman asked hopefully.

"I pulled on it pretty hard—didn't help any," the boilermaker told him.

"Hell fire, man, she's called for 5:00 and the superintendent sitting with a watch in his hand waiting to eat me up if there's a minute delay! Ain't there something you can do?"

"I'll try again," Horton said in a hopeless tone and left the office. Evans followed him to the roundhouse.

The boilermaker heaved on the long handled washout plug wrench. If anything, the hissing jet of steam around the plug increased. "Hand me a piece of pipe," Horton told his helper.

Increased leverage of the piece of pipe on the wrench handle did no good. "It's no use." The boilermaker shook his head.

"Ready to go?" It was the hostler come to take the engine out of the house.

Evans fished nervously in his jumper pocket for his plug of "horseshoe." "Not quite," he said to the hostler, "may have to blow her down," he added.

"Pitch me a calking chisel and hammer," Horton told his helper. "All right, it's not leaking now," the boilermaker announced a few minutes later.

There was no delay leaving Plainville and the plug didn't leak, but a government inspector slapped a Form-5 on the 5091 at Sanford, the next division point. How the inspector happened to see the calked plug is still a mystery, but he saw it, and the fruit train was held over an hour getting another engine ready.

At the investigation, Evans was forced to admit that he didn't tell Horton to calk the plug. The boilermaker was out of service thirty days despite the foreman's protest.

That was one that didn't get by even though motivated by the best of intentions. It does show that boilermakers are loyal and conscientious in their work sometimes even to the point of risking their jobs. Horton knew it was a violation to calk a washout plug.

SOMETIMES a boilermaker will even go further and jeopardize his own safety to prevent delay or failure in emergency, like Henry Barton did on the 5088. The safety rule book says that in all cases work must be performed in a safe manner, but even the officials that compiled the rules must admire the nerve of a man that will deliberately torture himself in a fire-box hot enough to broil a steak with a chance of being scalded with steam from a crack in the firebox wall, even if these same officials don't condone it.

The job Barton did in the fire-box of the 5088 was just as disagreeable and dangerous and required a lot more skill than driving a wooden plug in a leaky flue, but no one acclaimed Horton a hero. There was no good-looking girl to hold his grimy head and kiss his sooty face when he came out of the fire-box, either. Barton wasn't cut out for a hero, besides he hasn't got the build. Who ever heard of a pot-bellied hero?

Barton does the electric welding for the boilermakers' craft and he's good, too; rated by the welding supervisor as one of the best on the S. P. & W. The only drawback is his figure—if fire-box doors are made any smaller, or Barton's belly gets any bigger, he won't be able to get in a fire-box; it's a close squeeze now.

Business had picked up on the Plains Division, but the monthly allowance for maintenance of equipment hadn't been increased. The boilermaker's force, small enough normally, was having a hectic time trying to keep the work up with force reduced and work increased. Added to that, two engines that had been in storage and due for tests were put in service. Removal of flexible staybolt caps, hydrostatic tests, and other work came very near being straws that overloaded the camel, and the boilermakers were busy as two deaf and dumb women having an argument. Just to cap it off, one of the locomotives had to have a patch on the belly of the boiler and the other required a new neck on a siphon. That, together with the tests being due, were the reasons those particular engines were stored.

The engines were needed badly, but running repairs left little time for men to work on them, and Evans didn't dare work men overtime to get them out. Every mail brought at least one letter advising the foreman to stay within the allowance.

Each day when Evans figured the engine lineup and had enough locomotives to go around, he heaved a sigh of relief. Every day he was afraid at least one train would be without motive power, but somehow they made it.

At last the two locomotives out of storage were finished and Evans breathed freely for the first time in ten days. "Well, with two more 5000's, things don't look so bad," the foreman told John Harris, the clerk.

The office phone rang five minutes later. "Hello . . . Yes, clerk talking." Harris held his hand over the mouthpiece of the phone. "It's the train-delayer—says there'll be a special through here about 7:00 p.m. He wants a 5000."

"All right, give him the 5093." Evans mentioned one of the recently completed locomotives.

Evans finished making out the engine lineup, and had a whole locomotive left over. "We can drop the wheels on the 5087 when she gets in," he said. "Goodness knows, they need it. The driving boxes are pounding like pile drivers and the tires should have been renewed fifteen days ago."

The phone rang again. "Yes, this is the roundhouse

. . . Yes, Evans is right here." . . . "It's the delayer again, wants to talk to you, sounds like he's got a bee in his bonnet," Harris told the foreman.

Evans took the receiver. "Hello . . . Yes . . . What? Where did it happen? . . . All right, the 5086 will be ready to go in twenty minutes." And there was no extra engine.

Evans hung up the receiver. "The 5091 tore herself up—main pin broke," he told the clerk.

"Where did it happen?"

"Going down Clear Creek hill," Evans spoke over his shoulder as he left the office.

The 5091 got in to Plainville about 4:15. She was a wreck—the engine going down hill when the pin broke had almost stripped herself clean on the left side. Besides requiring a lot of work to repair the damage, the left main rod would have to be renewed, and there was none on hand. Evans shook his head dolefully when he looked the locomotive over. It would be a week at least before he could get the parts and have the 5091 back in service.

"Put her over the drop-pit," the foreman told the hostler. "Long as she'll have to be lined up anyway might as well get some of the work she needs done."

In the meantime boilermakers were having troubles of their own. Engines had made "one more trip" too many times and were getting to the point where they would make no more without being repaired. It seemed that every engine that came in needed a new set of brick in the fire-box. Hogheads were complaining that locomotives weren't steaming, front end leaks, oil burners needed adjusting, fire-box door liners needed renewing, and all of the other thousand and one things that can ail the power producing part of a locomotive.

THERE were no more engine failures for several days following but minor delays of five, ten, and fifteen minutes became as numerous as ants at a picnic and just as annoying until it finally got so bad that the vice-president in charge of operation visited Plainville. He was accompanied by the superintendent of motive power, the division superintendent, and half a dozen other lesser officers.

They spent the day in Plainville each vying with the other to see which could ask the most embarrassing questions. Questions were directed at H. H. Carter, master mechanic, but Evans knew he was the one on the pan.

Engine failures and delays came first in line of queries, all ending with the inevitable "why." Costs of turning engines came in with a close second. Before the day was over, they made the foreman feel that an engine failure came under the classification of a major crime and overtime rated with stealing pennies from a starving blind man.

The business car bearing the party of officials was to leave Plainville on 82, a Gold Ball freight called for 5:20 p.m. Evans assigned the 5074, what he thought was one of the best locomotives available for the train. After the engine was worked, the foreman looked the engine over for any possible defects, but he didn't look in the fire-box. If he had, he would have seen a rivulet of water trickling from a hair-line crack next to a seam in the fire-box wall.

The fire builder noticed it when he opened the fire door to throw in a blazing wad of oily waste to ignite the oil, but thought nothing of it. Water oozing from the crack didn't look any worse than other places that he knew would take up when the metal got hot.

At 4:00 the 5074 was setting on the lead ready to go. Davis, the outbound inspector, gave a final look before the crew came on. The hostler had killed the fire and shut off the blower. Davis noticed a cloud of steam coming from the peep hole in the fire-box door. He opened the door and a cloud of steam billowed out. The inspector didn't wait for a second look. He rushed to the office in search of Evans.

Evans looked in the fire-box and went to find Barton. The tiny hair-line crack in the fire-box wall had opened up under the two hundred and fifty pounds steam pressure Barton discovered when he cleared the fire-box by turning on the blower.

Evans swore fervently and fluently five minutes without repeating or stuttering. There wasn't another engine available that could be made ready in less than two hours. The foreman's rear end would look like a hunk of Swiss cheese by the time the officials finished eating on him.

After exhausting his vocabulary of profanity, Evans felt a little better. "Well, I guess we'll have to run her back in the house and blow her down," he said. "You can't do anything with it, can you?"

"I can try." Barton spoke in a matter of fact tone. "Bring me a calking chisel and hammer and string the welder leads out here," he added to his helper.

"You're not going in that fire-box and calk a leak with over two hundred pounds of steam on it," Evans told the boilermaker. "Besides, you couldn't calk it so it would hold."

"No, but I might weld it," Barton said. "Will you have a couple of laborers bring me half a dozen fire-brick to stand on?"

While the boilermaker helper was stringing out the welder leads, Barton opened a blow off cock and let the steam pressure go down to a hundred and twenty-five pounds. He threw the brick inside the fire-box and sprayed the firedoor ring with water.

As Barton wriggled through the fire door, there was a smell of scorching cloth. The raveled bottom of an overall leg burned as it dragged over the splash wall. When the welder cable was dragged into the fire-box, the acrid odor of burning rubber mingled with other smells in the cab.

"Gimme a hammer and chisel," Barton said.

Standing to one side to escape the rush of steam from the crack, the boilermaker calked the lower portion of the crack. He then ran a bead of weld over the place he had calked.

Calking and welding, he worked. Perspiration ran from his face in a stream. Steam from clothing soaked through with sweat mingled with that from the crack in the fire-box. Barton stumbled. His hand dropped to the hot brick on the side of the fire-box. The leather in the palm of his canvas glove wrinkled from the heat.

When the heat became unbearable, Barton would stick his head in front of the open fire-box door for a reviving breath of fresh air.

Painfully slow, it seemed the leak became smaller until only about two inches remained to weld. It was the most stubborn of all. The weld refused to stick over the rushing jet of steam and calking wouldn't hold.

"Come on out and let it go!" Evans yelled into the fire-box.

"Damned if I do," Barton gritted. "Turn some cold water on me," he panted, as he hammered the calking chisel.

The spot held. The boilermaker picked up the electrode holder. When the arc was struck the seam opened again. The jet of steam played against the welding shield. A blister formed on an unprotected ear. Barton reeled as though he would fall.

He picked up the hammer and chisel again; desper-

ately the boilermaker hammered with all his waning strength. The spray of steam diminished, became just a wisp, then ceased. That time the weld held. The job was finished. Only a line of welding showed where the crack had been.

Barton stumbled to the fire door and collapsed with his head just outside. The fire builder and the boilermaker helper dragged Barton out of the fire-box. There was something suspiciously like tears in Evans' eyes as he looked at the blistered face of the boilermaker.

Barton wasn't out long. He soon revived in the fresh air of the cab. "Phew!" he sighed, "gimme a drink of water and a cigarette."

It's against rules to smoke on the job, but Evans lit the cigarette.

"That was a helluva hot job!" Barton remarked fifteen minutes later as he started back to the roundhouse to finish a job he had started there.

Shop Improvements at North Platte

The Union Pacific recently completed and now is using a new locomotive shop building at North Platte, Neb., one of its main-line points. In it has been installed the machinery formerly housed in a section of the roundhouse, together with some new units of equipment and a 20-ton traveling crane which has greatly increased the scope of work that can be handled at this point.

Exclusive of the existing machinery, the new building and new equipment represent an investment of about $225,000. The structure is 228 ft. long and 95 ft. wide and the shop building is 34 ft. high under the trusses. Along one entire side are the offices and other separate rooms, including tool room, electric shop, air room and locker, toilet and wash room facilities.

The building is of steel frame, covered with corrugated transite and insulated with 2 in. of rock wool. It is finished inside with Flexboard. The windows are all of heavy wired glass. Unit heaters and modern electric lighting fixtures are installed.

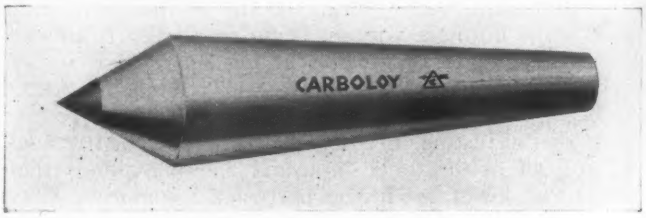
The new shop is connected directly with the roundhouse, so that locomotives can be run in for service over the two-track drop pit. Formerly shop machinery was housed in part of the roundhouse. Its removal releases 7 or 8 stalls for regular roundhouse running repairs.

The new equipment consists of a 36-in. shaper, a 24-in. roller-bearing-equipped precision engine lathe and a Micro internal rod grinder.

Included in the other machinery, which represents about $100,000, are four engine lathes of varying sizes, a driving-wheel lathe, a 600-ton hydraulic press, two 24-in. boring mills, a right line radio drill, a Columbia 32-in. shaper, a 30-in. by 30-in. by 12-ft. planer and a 36-in. punch and shear and other equipment necessary for the general shopping of locomotives.

Lathe and Grinder Centers Tipped with Carboloy

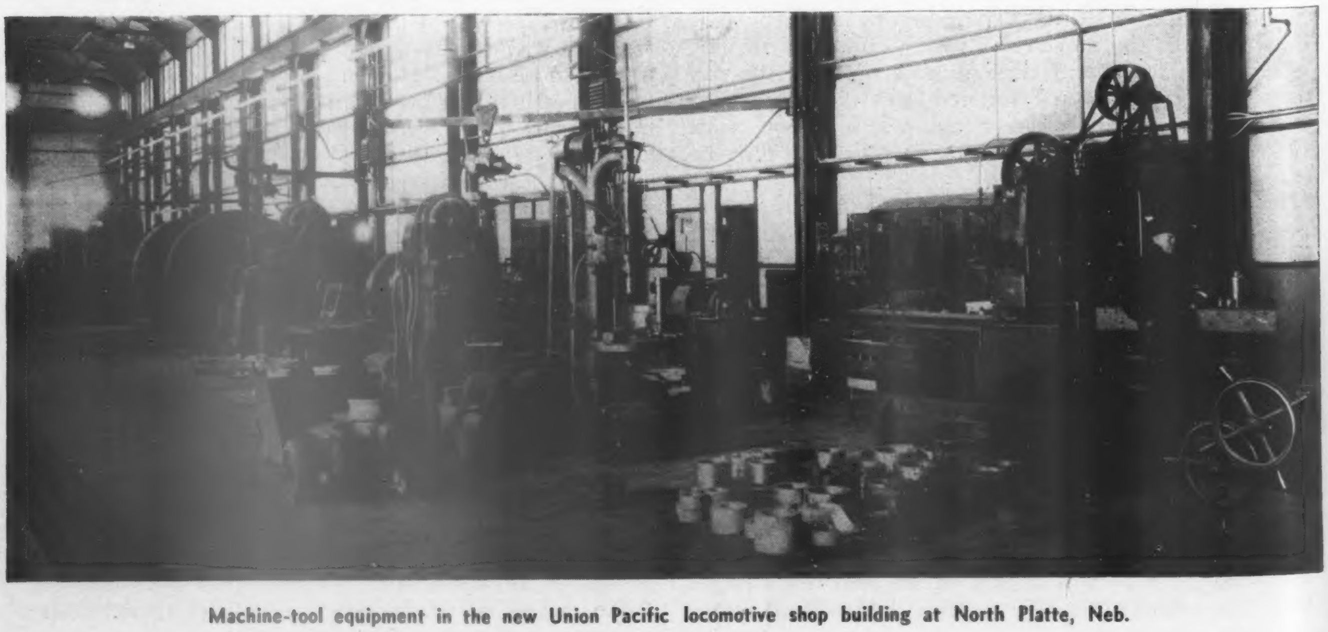
Carboloy Company, Inc., Detroit, Mich., has developed a special application of Carboloy on lathe and grinder centers. These centers are the same as regular steel centers except that a Carboloy cone-shaped tip is substituted for the ordinary steel tips. Because of their diamond-like hardness, cemented carbides are suited to resist the extreme wear on these centers, particularly



Lathe center with Carboloy tip

where the work is nitrided, case hardened, or heat-treated shafts. One report shows that in S.A.E.-2335 steel shafting, Carboloy centers stood up three years with one regrinding whereas ordinary centers lasted only one week. Reports to date shows that these centers wear 50 times longer than ordinary centers.

Besides its longer life, users report greater accuracy, elimination of burning and scoring, and fewer reconditionings. The centers are available in all sizes.



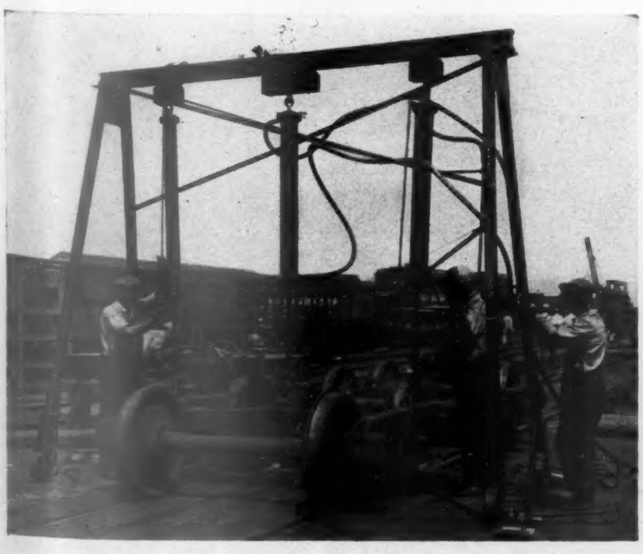
Machine-tool equipment in the new Union Pacific locomotive shop building at North Platte, Neb.

With the Car Foremen and Inspectors

General office building, storeroom and air brake room at C. & N. W. car repair yard, North Proviso, Ill.

Repairing Auto Cars At North Proviso

At the Chicago & North Western car repair yard, North Proviso, Ill., heavy repairs are now being given to a series of 998 automobile box cars, which were built new in 1928, subsequently equipped with Evans automobile loaders, and now being put over the repair tracks for new cast-steel side-frame trucks; dropping and repairing all draft gears; giving general repairs to the car superstructures, doors and roofs; applying new floors; loading devices inspected and repaired; air brakes repaired, cleaned and tested; cars repainted and stenciled. An output of at least 6 cars a day is secured with a force of 100 men, including the supervision, working 8 hours a day and 5 days a week.



Portable truck-repair crane equipped with three pneumatic hoists

General Method of Operation

In common with other car-repair points on the C. & N. W., principal interest at North Proviso centers on safety and, with this objective in view, all materials, in so far as possible, are neatly stacked and the shops and grounds are kept clean and orderly, a fact well borne out in the illustration which shows the general office building, storehouse, air brake room, etc. This same illustration also shows quite clearly the narrow-gage rails which form part of the material-handling system provided for the easy handling of heavy materials from the storeroom and shops to all parts of the repair tracks with a minimum of manual labor. Numerous switches, run-around tracks and loading tracks are located as required and the mechanical equipment includes three gasoline engine-driven tractors and 50 narrow-gage trailers. One of these tractors with two car-wheel buggies ahead and a lumber trailer behind is shown in another of the illustrations.

The principal advantage of this narrow-gage track and equipment is that, for a comparatively small investment, reliable means of handling heavy materials is provided which involves minimum manual labor and may be depended upon to function regardless of adverse weather and roadway conditions, such as snow, ice, water-softened roadways, etc. Low power required, speedy delivery and the fact that the trailers can be easily moved a little by hand if necessary, after being spotted at a

The three tracks which are devoted to making heavy repairs of automobile box cars

car, are important additional advantages of the narrow-gage material-delivery system as demonstrated by experience on the C. & N. W. As compared with concrete highways and automotive-type equipment, the narrow-gage system also has the additional advantage that, with revised operating conditions and requirements, the tracks may be easily relocated or taken up if necessary.

One of the narrow-gage tractors mentioned is equipped with a boom and hoist which greatly facilitates loading heavy materials on the trailers. For still heavier material-handling operations throughout the yard, a Burro gasoline-engine-driven tractor, operating on standard-gage tracks and equipped with a 30-ft. boom and cable hoist, is used.

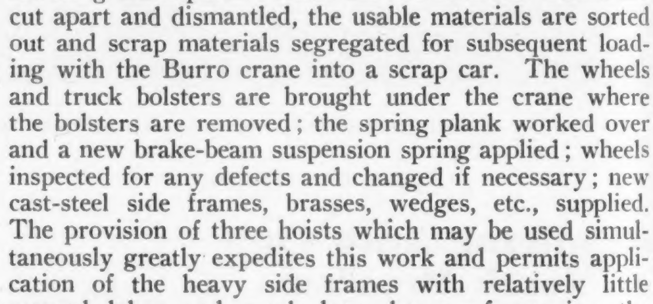
New Cast-Steel Truck Sides Applied

One of the principal jobs in connection with repairing the automobile box cars is the application of new cast-steel side frames to the trucks. The cars are switched to three of the shop tracks, as shown in one of the illustrations, there being twelve cars per track, evenly spaced between the track crossings. The first operation is to jack all of the cars on one track using a pair of air-operated jacks, one of which is shown in a separate illustration. The car bodies are set on substantial three-leg wooden horses, 5 ft. high, and all of the trucks are pushed out to the north end of the track, where they are inspected and rebuilt and then worked back under the cars in the reverse order.

The portable truck-repair crane, equipped with air hoists and used in making truck changes is shown in two of the illustrations. After all of the trucks on one track have been repaired and run back under their respective cars, the cars are jacked down and the car bodies on one of the adjacent tracks are jacked up. The trucks from the second group of 12 cars are moved out, the truck-repair crane placed over this track and the trucks overhauled and worked back under their respective cars as previously described. The same operation is then followed with cars on the third track.

Referring to the close-up view of the truck-repair crane the general construction will be evident. The top cross beam, 11 ft. high, is 12½ ft. long and made of a section of 90-lb. rail. The A-shape side frames are made of 3-in. I-beams, suitably braced and welded to the cross rail at the top and equipped with 10-in. wheels at the bottom, the width of the *A* frame at the base being 63 in. The frame is suitably stiffened by cross braces welded in place and three 5-in. by 52-in. air hoists are suspended from suitable roller-equipped blocks which may be easily moved along the top rail.

The advantage of this type of crane is its flexibility and the elimination of all manual labor in raising or lowering truck parts. After the old arch-bar trucks are cut apart and dismantled, the usable materials are sorted out and scrap materials segregated for subsequent loading with the Burro crane into a scrap car. The wheels and truck bolsters are brought under the crane where the bolsters are removed; the spring plank worked over and a new brake-beam suspension spring applied; wheels inspected for any defects and changed if necessary; new cast-steel side frames, brasses, wedges, etc., supplied. The provision of three hoists which may be used simultaneously greatly expedites this work and permits application of the heavy side frames with relatively little manual labor and much less chance of marring the journals. The truck then moves south to the next position where new brake-beam bottom rods and supports



Safety step-ladder used in making repairs to door hangers and end platforms—Note slots provided for individual hand tools to prevent danger of dropping them

are applied, as are also the journal-box covers and dust-guard plugs.

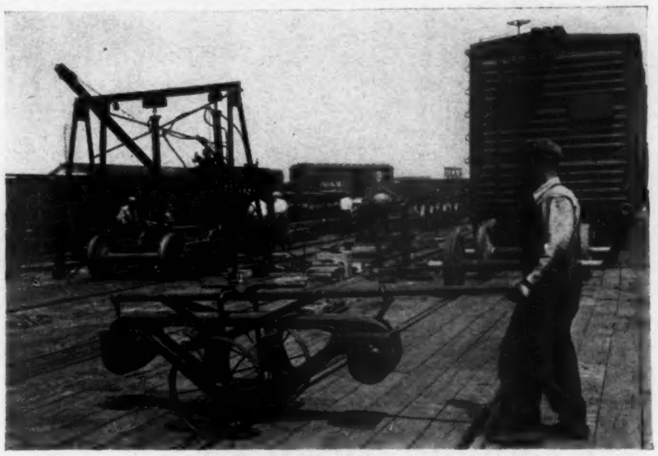
Handling Cast-Steel Side Frames

In connection with the application of the cast-steel side frames, these somewhat heavy and awkward castings are handled to the truck repair position by means of a special two-wheel buggy, clearly shown in one of the illustrations. This buggy consists simply of a welded steel framework mounted on two 24-in. wheels and provided with a stationary hook to engage and support one end of the side frame while a sliding hook engages the other end. These two hooks are about equally distant from the wheel centers so that the side frame is in approximate balance and one man can easily move it wherever desired over smooth ground or a plank floor.

The upper bar of this buggy consists of a piece of 1½-in. pipe, 36 in. long from the hook end to the wheel support and 68 in. long from the wheel support to the short cross-bar handle used in moving the buggy. The buggy frame is braced with strips of ½-in. by 2-in. steel welded to the top bar and to the wheel inverted U-frame, thus making the buggy both light and strong. This buggy, is similar in construction to the one shown in another illustration and used for moving air jacks.

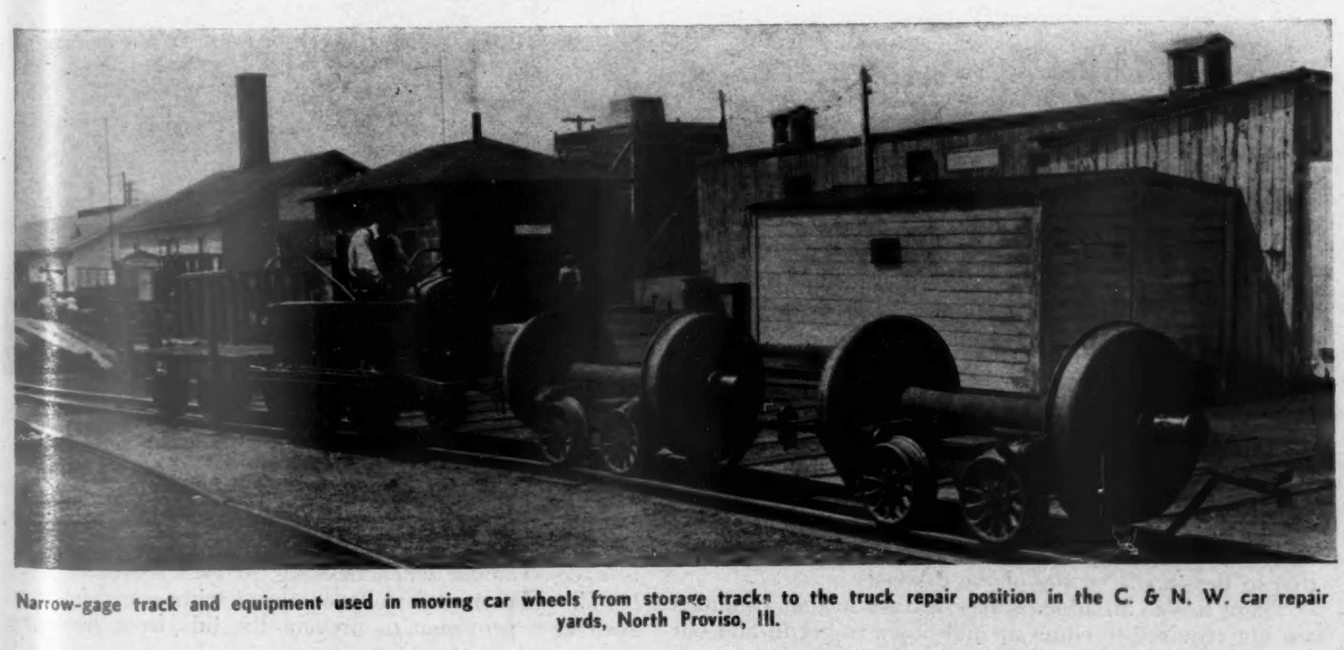
Light but strong two-wheel buggy used in moving the heavy air jacks

Still another device satisfactorily used at North Proviso in connection with the repair of these automobile cars is the safety step ladder shown in a separate illustration. This safety ladder, 12 ft. high overall, is made of 1¼-in. by 3½-in. wood side rails at the front and 1¼-in. by 2¼-in. side rails at the rear. The steps are ⅞ in. by 4¼ in. by 25 in. with the exception of the safety platform, 24 in. down from the top, which is 16 in. by 25 in. The step ladder is hinged at the top in the usual manner and equipped with reliable folding brackets to provide stiffness. A safety hand rail, made of ⅜-in. pipe, is applied to each side of the ladder. The top board is equipped with slots to receive such tools as hand saws, bit brace, hammer, wrench, etc. The ladder weighs 75 to 100 lb.



Cast steel side frames are easily moved by one man using the two-wheel buggy

As shown in the illustration, this portable ladder provides a safe footing for car men when doing any work around the top of the car doors or end platforms which would otherwise be awkward to reach especially when loaded down with several small tools. In addition, the use of these tools on makeshift scaffolds presents a constant hazard due to the possibility of one or more of the tools accidentally dropping on a workman underneath.



Narrow-gage track and equipment used in moving car wheels from storage tracks to the truck repair position in the C. & N. W. car repair yards, North Proviso, Ill.

Rebuilt Milwaukee caboose in which the cupola has been replaced by side bay windows

Milwaukee Rebuilds Caboose Cars

The Chicago, Milwaukee, St. Paul & Pacific is now working on an extensive program of rebuilding and improving cabooses operated on this road and a total of 24 cars had been completed by April 1. Among important changes in construction is the removal of the familiar cupola and its replacement by a bay window on each side of the car; rearrangement of the entire interior to permit applying a standard reversible coach seat in each window; relocation of lockers, application of ¼-in. 3-ply plywood ceiling for improved appearance and insulation; use of safety glass in end door and bay end windows; replacement of old stove by more efficient Pyro-pad stove; and replacement of the old oil lamp over the desk by a modified Acme oil lamp and special reflector which increases the number of foot-candles at desk level from 2 to 18.

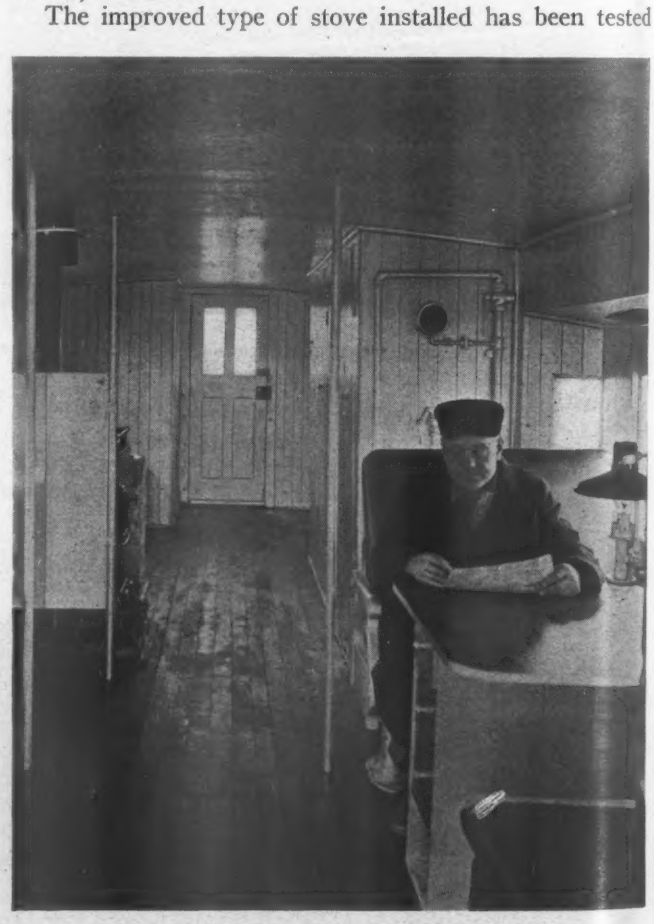
The old swing motion trucks are being repaired and replaced. Both the interior and exterior of the car are sprayed with aluminum paint, which gives the car an unusually clean and neat appearance. The striking effect of this light metallic color is accentuated by black stencilling on the car sides, and the trucks, underframe, end platforms also are painted black. An air whistle is installed on each end of the car. Another feature, not generally used on cabooses, is the provision of a car journal brass and wedge locker which can be conveniently reached from the ground level outside the car. The advantages of this arrangement are self evident and the locker provides a safe place for the storage of car brass, as it is normally kept locked.

Advantages of the Bay Window Construction

The reason for replacing the cupolas with side bay windows is to permit the trainmen to sit in the caboose and inspect the train more easily as it is going along and note that there are no brake beams or truck parts dragging. Also they can readily detect hot journals. The presence of a hot journal often is detected by the odor arising from the burning of the oil-soaked waste used for lubricating the journal, and as these odors usually hang close to the ground, it is easier for the trainmen to detect them by opening the sliding window in the side of the bay occasionally than it would be if they were sitting in the cupola on top of the caboose.

There is also an added safety feature in that trainmen are not required to climb up and down to get in and out of the cupola. There have been accidents resulting from men having to climb up into the cupolas or when coming down out of them. Removal of the cupola has also permitted removal of the partitions in the car, resulting in a roomier, more airy, and more readily-heated caboose, as stated.

The improved type of stove installed has been tested



Interior of rebuilt Milwaukee caboose showing bay window construction, plywood ceiling and improved lighting table lamp installation

and found to be very efficient as well as economical. The top of the stove is arranged to permit trainmen to cook food and prepare coffee. Also a grill is provided which is a convenience when desiring to grill meats or toast bread. The stove is fully equipped with safety features, such as a provision to prevent the lids from becoming

displaced and doors opening, etc., in the event of an accident which might upset the stove.

The cabooses are provided with side seats 6 ft. long which are upholstered in leather, and are used by trainmen to make up beds during the time that they are at the terminal at the opposite end of their run. The standard coach seats in the side bays permit trainmen to assume a comfortable position when working at the desk, or watching the operation of the train.

Toilet facilities are also provided, as well as tool lockers and other conveniences such as washstand with water supply, and refrigerator in which to keep foodstuffs.

Special Attention to Lighting

A survey of lighting conditions in caboose cars with the usual type of oil lamp installations having indicated generally unsatisfactory conditions with a light intensity not in excess of 2 ft.-candles in certain instances, it was decided to effect a substantial improvement in the lighting of the rebuilt cabooses. By locating the single Acme lamp directly over the writing table, as shown in one of the illustrations and installing a special Benjamin 10-in. shallow type reflector, a marked improvement was secured. The lamp is mounted with the wick line 11 in. above the table and the reflector spaced with its edge 1⅜ in. above the wick line.

Using a Weston No. 703 foot-candle meter a series of measurements of light intensity at various points on the writing table were made. The table top is 30 in. wide by 39 in. long and the light intensity with this improved lamp installed varied from 6 ft.-candles at the table edges to 14, 18 and 20 ft.-candles as the meter was brought nearer to the center of the table. This may be compared with a light intensity of 10 to 12 ft.-candles which is all that is available in many of the older passenger coaches.

Questions and Answers On the AB Brake

Operation of the Equipment (Continued)

185—*Q.—What is the effect?* A.—Further flow of quick-action-chamber air to the atmosphere is cut off, and communication is re-established between the brake pipe and the quick-action chamber.

186—*Q.—By what means does a local emergency rate of reduction of brake-pipe air take place in the first stage of emergency?* A.—The vent valve in the emergency portion unseats, opening a large direct passage from the brake pipe to the atmosphere.

187—*Q.—What movement is the cause of the vent valve unseating?* A.—The emergency piston moves to the right, compressing its spring, allowing the graduating valve to move far enough on the slide valve to uncover a port connecting the quick-action-chamber to the chamber at the left of the vent-valve piston. The resultant movement of the vent-valve piston unseats the vent valve.

188—*Q.—During the initial movement of the emergency piston and graduating valve, does the opening from the quick-action-chamber to the atmosphere via the graduating valve and slide valve retard the movement of the emergency piston to the right?* A.—No.

189—*Q.—Why not?* A.—The quick-action-chamber air cannot reduce to atmosphere at the same rate as the brake-pipe pressure; therefore, sufficient differential is built up across the emergency piston to bring about the movement as described.

190—*Q.—What movement in the emergency portion does the rapid rate of reduction finally bring about?* A.—The emergency piston moves to the extreme right carrying the slide valve with it.

191—*Q.—How does the movement of the emergency slide valve effect communication between the quick action chamber and the vent valve piston chamber?* A.—The slide valve moves out of register with the one in the seat, but the slide valve movement uncovers port *H* in the seat, with the result that communication is open between the two chambers.

192—*Q.—How does this position affect the build-up of the brake cylinder?* A.—The emergency reservoir is connected by cavity *K* in the emergency slide valve through passages leading to the inshot valve. As the inshot valve is unseated at this time, pressure is free to flow past the valve to a passage leading to the brake cylinder connection.

193—*Q.—How is the service portion affected by the emergency rate of reduction?* A.—The service piston and the slide valve move to the extreme left, permitting auxiliary reservoir pressure to flow past the service graduating valve, through the service slide valve and seat to the passage leading to the inshot valve.

194—*Q.—Does this flow of air unite with the flow from the emergency reservoir?* A.—Yes. The auxiliary and the emergency reservoir air combine, flowing past the unseated inshot valve to the brake cylinder passage.

195—*Q.—Is there any pressure in the inshot piston volume, or on the spring side of the inshot piston at this time?* A.—No. The emergency slide valve has blanked this port connection in its seat.

196—*Q.—How does this affect the position of the inshot valve?* A.—The inshot piston spring holds the valve open, permitting an unrestricted flow to the brake cylinder.

197—*Q.—What is the maximum brake cylinder pressure obtainable in the first stage emergency?* A.—15 lb.

198—*Q.—What movement limits the amount of pressure?* A.—The force of the inshot piston spring is overcome when 15 lb. brake cylinder pressure is developed and the piston moves to the left, permitting the inshot valve spring to close the valve.

199—*Q.—What is the approximate time required to obtain 15 lb. brake cylinder pressure in the first stage of emergency?* A.—1¼ sec.

200—*Q.—What change in the rate of the brake cylinder build-up occurs in the second stage emergency?* A.—As the inshot valve is now closed, a delayed build-up is now ensuing through the delay choke only.

201—*Q.—For approximately how many seconds does the delayed build-up continue?* A.—5¼ sec.

202—*Q.—How much brake cylinder pressure is developed during the second stage emergency?* A.—The pressure builds up from the 15 lb. obtained in the first stage to approximately 43 lb.

203—*Q.—What movement terminates the duration of the second stage emergency or delayed build-up?* A.—The unseating of the timing valve. This is also the beginning of the third or final stage.

204—*Q.—Explain the unseating of the timing valve.* A.—The quick-action-chamber pressure is on the left of the timing valve, while the brake cylinder air is on the right. Brake cylinder pressure has been increasing while quick-action chamber-air is being reduced to the atmosphere. When this pressure has been reduced to a certain relation to the brake cylinder pressure, the timing valve unseats.

205—*Q.—In what way does this change the rate of the flow to the brake cylinder?* A.—The unseating of the timing valve permits the air to flow to the brake

cylinder through the timing valve choke in addition to that supplied through the delay choke.

206—*Q.—Approximately what time is involved in the third stage of final build-up?* A.—2½ sec.

207—*Q.—What pressure is finally developed in the brake cylinder?* A.—60 lb.

208.—*Q.—In summing up the three stage operation, what does it provide?* A.—An initial inshot of the pressure from the combined auxiliary and emergency reservoirs to the brake cylinder of a limited amount but at an unrestricted rate, followed by a delayed build-up, and finally a fast rate to equalization.

209—*Q.—When is this controlled brake cylinder pressure development modified?* A.—When a partial service brake application precedes an emergency.

210—*Q.—When is it completely annulled?* A.—When the brake application has in service 30 lb. or more brake cylinder pressure previous to the emergency application.

211—*Q.—What does the amount of the inshot pressure and the delay time before the final build-up depend upon?* A.—It depends on the amount of brake cylinder pressure in the inshot piston volume and on the left of the inshot piston at the time the emergency takes place.

212—*Q.—Why is a higher brake cylinder pressure obtainable during emergency than in a full-service application?* A.—Because both the auxiliary and the emergency reservoirs equalize into the brake cylinder.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Re-Light-Weighing Car Within Date

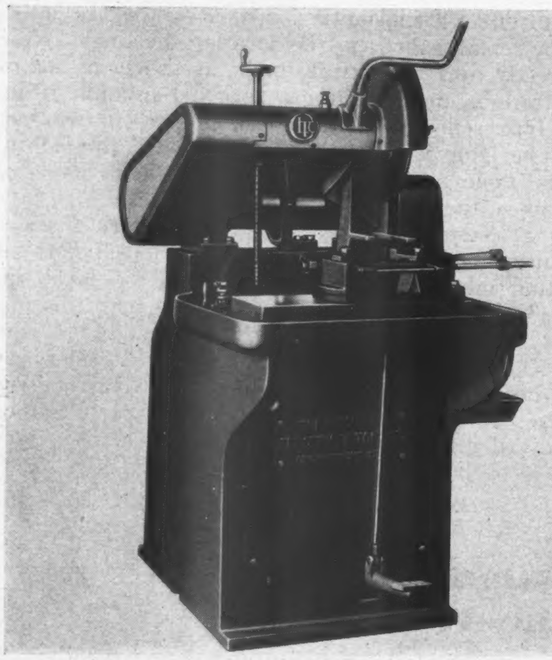
The Seaboard Air Line reweighed and restenciled the Central Vermont car 41099 at Hermitage, Va., July 5, 1934, the previous weighing date on which was July, 1932, and rendered a charge amounting to $16.59. The car owner took exception to the charge, claiming that old weight was not out of date, citing paragraph (B), A.A.R. Rule 30, and Interpretation No. 4 thereto.

The Seaboard Air Line agreed that the car was reweighed in the 24th month instead of after the expiration of 24 months, and that technically the car was not due for reweighing. However, it quoted a previous case involving a S.A.L. car on which air brakes had been cleaned by another road on the last day of the 12-month period and not after the expiration of 12 months. In this case the Arbitration Committee supported the contention that the car was not due for cleaning but suggested that the car owner accept the charge because of the nearness of the expiration of the 12-month period and because no complaint had been made as to the character of the work. The car owner protested this suggestion but was made to accept the charge. The S.A.L. contended that since the reweighing of the Central Vermont car was done in the 24th month and that the cleaning of the brakes on the car in the quoted case was done on the last day of the 12-month period, and since reweighing is figured on a monthly basis and brake cleaning is figured on a daily basis, the two cases are exactly alike in principle.

In a decision rendered Nov. 14, 1935, the Arbitration Committee said, "Interpretation No. 4 to Rule 30 applies. The contention of the Seaboard Air Lines is not sustained."—*Case No. 1748, Central Vermont versus Seaboard Air Line.*

Wet Abrasive Cut-Off Machine

The Cincinnati Electrical Tool Company, Cincinnati, Ohio, has announced a wet abrasive cut-off machine suitable for straight or angle cutting of practically any material, including steel alloys, non-ferrous metals such as brass, copper, aluminum, as well as fibrous and plastic materials in various sizes, angles and shapes. The wet-



Cincinnati wet abrasive cut-off machine for steel, non-ferrous metals, and fibrous and plastic materials

cutting feature was developed not only to increase the life of the abrasive cut-off wheels, but also to produce a cut with a minimum of burr and to eliminate burning. The coolant is directed not only on the point of contact of the cut, but on the sides of the wheel as well.

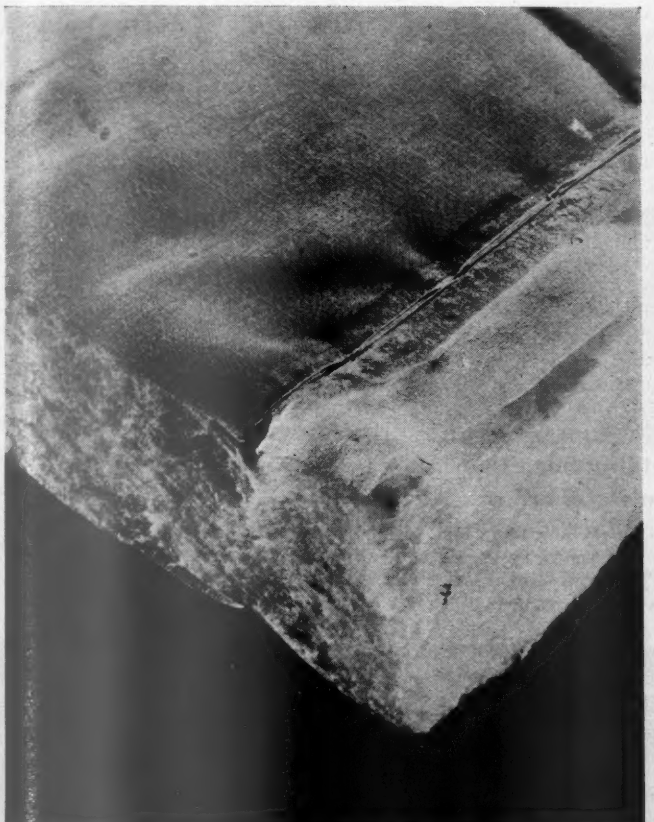
The machine is suitable for making straight or angle cuts in solids up to 2¼ in. or tubing up to 3½ in. diameter, the same vise being suitable for the various cuts. In cutting angles up to 45 deg., however, the maximum capacity is 2¼ in. Graduations on the table facilitate angle-cutting. A stop is provided which can be set for any depth of cut within the machine's capacity, and a longitudinal stop is provided for regulating the length of the material to be cut.

The material is held in the vise by spring tension on the jaws and the work is released by the foot lever after the cut is completed, leaving the operator's hands free at all times. The work is held on both sides of the cut, eliminating the possible cramping of work and preventing wheel breakage. The abrasive wheel is moved into the work by means of a hand lever; the arm which carries the abrasive wheel pivots on the pedestal with a counterbalance to facilitate operation. The abrasive cut-off wheel is completely guarded, with exception of that portion necessary for the actual cutting operation.

Two sets of wheel flanges, in different sizes, are furnished to ensure the maximum use of the abrasive wheels. A shaft locking device facilitates changing of wheels. The coolant system consists of a ¼-hp. motor-driven centrifugal pump with 10-gal. tank, piping and control drive. The spindle is of nickel-steel, mounted on sealed-type deep-groove ball bearings running in oil. Labyrinth seals are used to prevent the ingress of grit or dirt into the bearing housings. The spindle is driven by multiple V-belts from a 7½-hp. ball-bearing drip-proof motor running at 1,800 r.p.m., mounted in the pedestal with magnetic starter with overload and no voltage protection and push-button control. The machine can also be furnished with a 10- or 15-hp. motor if desired.

Fibrous Glass Insulation For Railway Equipment

Two types of insulating blankets of fibrous glass, one type for refrigerator cars and passenger cars, and another for locomotives, have just been placed upon the market by the Armstrong Cork Products Company, Lancaster, Pa. Both of these use as its basic material



Armstrong-Corning fibrous-glass wool insulation for refrigerator and passenger cars and locomotives

the Armstrong-Corning wool insulation made by the Corning Glass Works, Corning, N. Y., and sold by Armstrong. The insulating blankets for refrigerator and passenger cars are available in thicknesses from ¾ in. to 5 in., and in sizes up to 9 ft. by 50 ft., or longer if required. They may be had faced on one or both sides with Sisalkraft, muslin, flame-proof muslin, or any specified material. In addition to the blankets, this insulation is available in plain bats, rolls and other usable forms.

For locomotive insulation, metal-mesh blankets of Armstrong-Corning wool insulation are available in thicknesses from 1 in. to 6 in. These insulating blankets are stitched with asbestos twine to metal fabrics, such as metal lath, hexagonal-mesh woven wire, or fly screen applied to one or both sides of the blanket as required. This insulation is said to be effective for temperatures up to 900 deg. F. and weighs approximately one-fifth as much as materials now being used.

Lightweight Lantern For Inspectors

A lightweight carbide lantern weighing approximately 6 lb., and equipped with a safety flame protector, heat-resisting glass lens and porcelain burner tips has recently been made available by the National Carbide Corporation, New York. It was designed primarily to

The National Carbide NJ-1 inspector's lantern equipped with a safety flame protector, heat-resisting glass lens and insulated handle

meet the requirements of car inspectors and has the following features: It can be used for eight hours on one charge of carbide, and it has an insulated handle to protect the workman against third rails and any exposed electric equipment, a positive water-feed control and a patented rear light of any desired color specified by the purchaser.

To insure long service and prevent corrosion, brass has been used in fabricating the water-carbide chambers. A novel and convenient feature of the lantern is the treatment of the threads joining the upper part of the lantern with the carbide chamber. In order to prevent damage when shaking out the contents of the carbide chamber, the usual arrangement has been reversed and the inside threads placed inside the chamber and outside threads on the upper part of the lantern.

Among the Clubs and Associations

Oil and Gas Power Meeting

THE Oil and Gas Power Division of the American Society of Mechanical Engineers will hold its tenth annual national meeting at State College, Pa., August 18 to 21. The program includes several items of interest to railroad men. Among these are the following:

WEDNESDAY, AUGUST 18
2 p. m.
General Session

Progress Reports by American Locomotive Company, Atlas Imperial Diesel Engine Company, The Buda Company, Caterpillar Tractor Company, Davenport Besler Corporation, DeLaVergne Engine Company, General Motors Corporation, Ingersoll-Rand Company, Nordberg Manufacturing Company, and others.

U. S. Navy Contributions to Diesel Engine Development, by E. C. Magdeburger, Bureau of Engineering, U. S. Navy Department.

THURSDAY, AUGUST 19
9:30 a. m.
Fuels and Lubrication Session

Lubrication Problems in Connection with High-Speed Diesel Engines, by C. G. A. Rosen, Caterpillar Tractor Company.

Correlation of Laboratory Tests on Fuel Oils with Field Operation, by W. F. Joachim, U. S. Naval Experiment Station.

2 p. m.
Transportation Session

Recent Developments in Automotive Type Diesel Engines, by O. D. Treiber, Hercules Motors Corporation.

FRIDAY, AUGUST 20
9:30 a. m.
Operating Session

1936 Oil Engine Power Cost Report, by H. C. Major, chairman, Oil Engine Power Cost Sub-Committee.

Waste Heat Recovery from Diesel Engines, by Glenn C. Boyer, Burns & McDonnell Engineering Company.

Penn State Method of Testing Diesel Fuels, by J. S. Chandler, Pennsylvania State College.

SATURDAY, AUGUST 21
9:30 a. m.
Research Session

Oil Flow Through Fuel Nozzles, by Prof. K. J. DeJuhasz, Penn State College.

Polymerization of Fuel Oils, by Gustav Egloff, Universal Oil Products Company.

There will be an exhibit of Diesel engine parts and accessories held in connection with this meeting.

Eastern Car Foremen's Outing

THE Eastern Car Foremen's Association held its annual outing, known as New Haven Day, at the Race Brook Country Club, New Haven, on July 15. Approximately 220 railroad and supply men attended. The program was of a varied nature and provided a number of competitive events. The winners of the principal ones were as follows: In the golf tournament L. H. Foster, of the Chicago Railway Equipment Company, took the prize for the low net score, while the low gross prize went to Ray P. Townsend of Johns-Manville Sales Corporation. The low net prize in Class B went to J. F. Daley of the New Haven, and the low gross prize went to A. Bixby, of Sponge Rubber Products Company. The low net prize in Class C went to W. F. Clarke, New Haven, and the low gross prize was taken by K. Cartwright, New York, New Haven & Hartford. Harry Nunn, of the Boston & Albany, took the prize for the longest drive. In the putting contest for golfers, first prize was taken by C. C. Hubbell of the Delaware, Lackawanna & Western, and second prize by P. D. Malloy, of Gustin-Bacon Manufacturing Company. There was also a putting contest for non-golfers, in which first prize was taken by Charles Hillers, L. C. Chase & Company, and second prize by L. J. McClain, Delaware & Hudson. The first and second prizes in the quoits contest were taken by Carl Dierks and Arthur Bibb, both of the Delaware & Hudson.

American Welding Society To Meet in October

THE eighteenth annual meeting and welding exposition of the American Welding Society will be held at Atlantic City, N. J., on October 18-22, the meeting at the Hotel Traymore and the exposition at Convention Hall. Technical sessions on industrial research and fundamental research in welding, a joint session with the American Society of Mechanical Engineers, a Symposium on Alloy Steels and a Railroad Session are among the features scheduled on the tentative program which is, in part, as follows:

MONDAY, OCTOBER 18
2 p. m.
Industrial Research

Weldability of Low Alloy Steels, by W. L. Warner, Watertown Arsenal.

Survey of Low-Alloy Steels as to Weldability, by J. H. Critchet, Union Carbide & Carbon Research Laboratories.

The Problem of Correlation of Radiographs and Mechanical Tests of Welds, by J. T. Norton, Massachusetts Institute of Technology.

TUESDAY, OCTOBER 19
9:30 a. m.

A Study of Stress Relief in Metals by an X-Ray Method, by J. T. Norton, Massachusetts Institute of Technology.

2 p. m.

Static and Impact Tensile Properties of Stainless Steel Welds at Ordinary and Low Temperatures, by O. H. Henry, Polytechnic Institute of Brooklyn.

Joint Session with American Society of Mechanical Engineers

Resistance Welding Fabrication, by J. M. Cooper, General Electric Company.

Fusion Welded Fabrication, by H. N. Blackmon, Westinghouse Electric & Mfg. Co.

THURSDAY, OCTOBER 21
9:30 a. m.
Symposium on Alloy Steels

Low Alloy Steels, by G. S. Mikhalapov, Heintz Manufacturing Company.

FRIDAY, OCTOBER 22
9:30 a. m.
Railroad Session

Building Up Locomotive Drive Box, by I. T. Bennett, Revere Copper & Brass, Inc.

Machine Gas Cutting in Railroad Work, by H. Bass, New York Central.

Welding of Railroad Rolling Stock, by V. R. Willoughby, American Car and Foundry Company.

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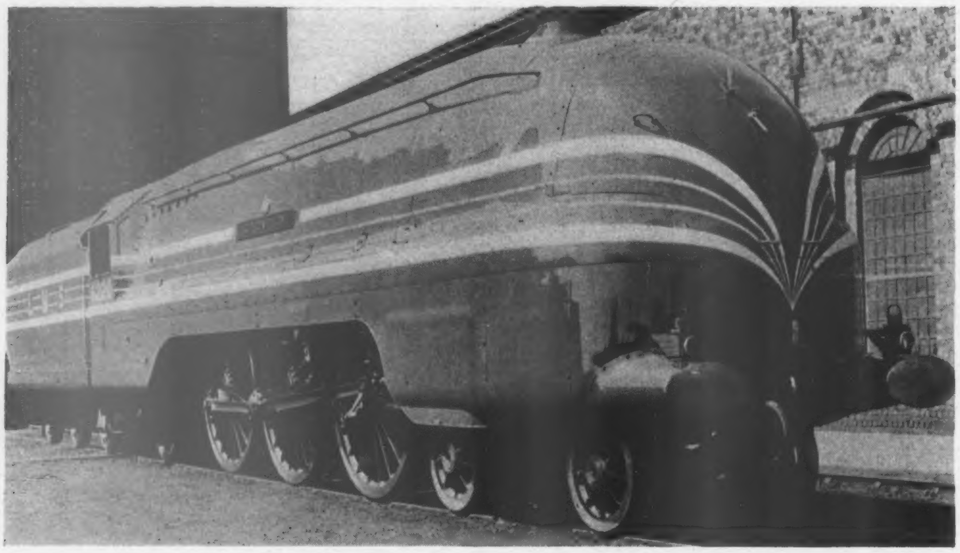
Delaware & Hudson car-foreman's twelfth annual outing held at Saratoga Lake, N. Y., July 17. This outing is sponsored by the D. & H. and serves jointly for discussion of car-department problems and recreation of car-department officers, their families and guests. A total of approximately 250 persons attended this year's outing



The "Coronation Scot," the first streamline locomotive of the London, Midland & Scottish Railway, for service between London and Glasgow

NEWS

New Construction

THE Northern Pacific has awarded a contract to the Standard Construction Company, Tacoma, Wash., for the construction of a one-story addition to its enginehouse and shops at Pasco, Wash., at a cost of about $40,000.

Air Brake Meeting Correction

IN the report of the concluding session of the Air Brake Association meeting, which was held at Atlantic City, the *Daily Railway Age* in its issue of June 21, page 1040D16, made the statement that the paper on the Type AB Empty and Load Brake Equipment, presented by the Pittsburgh Air Brake Club, was read by George Cotter, Westinghouse Air Brake Company. This paper, which was presented by the Pittsburgh Air Brake Club, was read by E. F. Richardson, assistant engineer of motive power, Bessemer & Lake Erie Railroad, and not by Mr. Cotter.

Pennsylvania Harrisburg Improvements to Cost $2,000,000

THE Pennsylvania, in connection with the extension of its electrified territory for both passenger and freight service westward from Paoli, Pa., to Harrisburg, has started work, at a cost of about $2,000,000, on the construction in Harrisburg of a new passenger engine terminal, a locomotive coaling station and a number of associated facilities. In connection with the building of the new facilities considerable track rearrangement will also be necessary.

The new enginehouse will be located just west of Harrisburg station, between Herr and McClay streets on the east side of the main line passenger tracks, and will be one of the largest on the Pennsylvania system. It will be built of brick and will contain 30 stalls, 18 of which will be 140 ft. in length and 12 of 120 ft. in length. A turntable in the center, 125 ft. long, will be the largest so far installed by the Pennsylvania. Included in the terminal facilities will be ash and inspection pits, an oil house and storehouse, a completely equipped machine shop, 80 ft. by 180 ft., and a welfare building for the enginehouse and train service employees.

It is planned to have the entire project completed by the close of the present year.

(*Turn to next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the July Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
C. M. St. P. & P.	1	4-8-4 oil-burn.	Company shops
Newburgh & South Shore	2	0-6-0	Lima Loco. Works
Newfoundland Ry.	1	2-8-2	North-British Loco. Co.
Phelps Dodge Co.	6	50-ton flat	Youngstown Steel Car Corp.
Roberval & Saguenay	1*	2-8-0	Canadian Loco. Co.

Locomotive Inquiries

E. J. & E.	7	Diesel-elec. switch.	....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Cabot, Godfrey L., Inc.	20†	Covered hopper	American Car & Fdry. Co.
Canadian National	30	Sand	National Steel Car Corp.
Chicago & North Western	50	Caboose underframes	American Car & Fdry. Co.
C. M. St. P. & P.	1,000	70-ton gondola	Company shops
Hercules Powder Co.	4	6,000-gal. tank	Gen. Amer. Trans. Corp.

Freight-Car Inquiries

Cambria & Indiana	500	50-ton hopper	....
Illinois Central	500	Hopper	....
Peoria & Pekin Union	25	Hopper	....
Texas & Pacific	500 or 1,000	Steel sheathed box	....
	100	50-ton hopper	....
U. S. Navy Dept., Bureau of Supplies and Accounts	2	70-ton flat	....
Utah Copper Co.	3	30-ton caboose	....

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
New York Central	6‡	Diners	Pullman-Std. Car Mfg. Co.
	4‡	Bagg. and mail	Pullman-Std. Car Mfg. Co.
Southern Pacific	2	Tavern	Pullman-Std. Car Mfg. Co.
	2	Coffee-shop	Pullman-Std. Car Mfg. Co.

* This locomotive, which has now been delivered, has a weight on drivers of 206,000 lb. and a maximum tractive power of 47,300 lb. The tender is of the eight-wheel type with a capacity for 7,000 imperial gallons of water and 14 tons of coal.

† These cars are to have a maximum capacity of 40 tons and are intended to carry approximately 32½ tons of granular carbon black. There are three compartments in each car with separate hopper outlets, and the cars are completely self-clearing by gravity.

‡ To be of light-weight alloy steel.

LUBRICATION

is a Major Problem

When the Franklin Automatic Driving Box Lubricator was first introduced, driving axle lubrication difficulties vanished.

Modifications in lubricator design suited to advances in locomotive design have been made, but the fundamental principle of grease reaching the axle through a perforated plate remains unchanged.

Assurance of proper lubrication can be had only when this perforated plate is properly designed and properly made.

These perforated plates, made for Franklin Driving Box Lubricators by the Franklin Railway Supply Company, Inc., are your assurance of properly lubricated, trouble-free driving journals.

When the cost of lubricator plates for a year's service on a locomotive is matched against the cost of one detention due to faulty lubrication the cost of Franklin lubricator plates becomes insignificant.

When maintenance is required, a replacement part assumes importance equal to that of the device itself and should be purchased with equal care. Use only genuine Franklin repair parts in Franklin equipment.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

To Conduct Research on Air-Conditioning Filters

THE Association of American Railroads, through the Division of Equipment Research, will conduct, this summer, a research of air-conditioning filters now in use on the railroads of the United States and Canada. The tests will be made in the engineering experimental laboratories of the University of Minnesota in accordance with the code adopted by the American Society of Heating and Ventilating Engineers. In addition to the laboratory tests, road tests will be made under actual operating conditions. The results of both road and laboratory tests will then be correlated.

It is felt that the dust specified by the code for testing purposes does not simulate the type of dust encountered in railroad service. In order, therefore, to develop a dust for testing purposes which is comparable to that actually encountered, samples are being obtained for analyzing purposes. The results of this research will be made available to the railroads before the next air-conditioning season.

"Rocket" Makes Maiden Trip

THREE light-weight, stainless steel cars constructed for the Chicago, Rock Island & Pacific for one of its "Rockets" made their first trip on July 12 when they carried a delegation of Chicago members of the Elks fraternity to the national convention at Denver, Colo. These cars, constructed for the train to operate between Kansas City and Denver, were hauled by an 1,800 hp. Diesel-electric locomotive and made the trip in 16 hr. 35 min., leaving Chicago at 7 a. m. and arriving in Denver at 11:35 p. m.

I. C. C. Ratifies Lyford Appointment

THE appointment of Frederick E. Lyford as sole trustee of the New York, Ontario & Western has been ratified by the Interstate Commerce Commission, which, at the same time, has denied the similar application of Vincent Dailey, who had been nominated by the court for the position of co-trustee with Mr. Lyford.

Frederick E. Lyford

Mr. Lyford had been associated with the Lehigh Valley in mechanical and special engineering capacities for ten years prior to 1934, when he became an examiner with the Railroad division of the Reconstruction Finance Corporation; since September, 1936, he has been assistant to the vice-president and director of sales of the Baldwin Locomotive Works.

Equipment Depreciation Orders

THE Interstate Commerce Commission has issued another series of sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies, prescribing equipment depreciation rates for the Detroit & Mackinac and five other small roads—the Milstead, the Mobile & Gulf, the Aberdeen & Rockfish, the Alabama Central, and the Carolina Southern. The composite percentages, which are not prescribed rates, range from 2.9 per cent for the Detroit & Mackinac to 13.61 per cent for the Alabama Central. The latter figure, however, is the rate prescribed for steam locomotives, since the road owns no other rolling stock. Prescribed rates for the Detroit & Mackinac are: Steam locomotives, 2.35 per cent; other locomotives, 9.75 per cent; freight-train cars, 2.58 per cent; passenger-train cars, 3.49 per cent; work equipment, 3.03 per cent; miscellaneous equipment, 18.48 per cent.

Supply Trade Notes

G. O. HAUSKINS, sales representative of the Peerless Equipment Company, with headquarters at New York, has been transferred to Chicago.

J. E. VAUGHN, assistant to the vice-president, of the Standard Railway Equipment Company and its associate, the Union Metal Products Company, has been transferred from the Chicago office to the New York office.

D. W. LAMOREAUX, whose appointment as vice-president of the Peerless Equipment Company, Chicago, was announced in the July issue of the *Railway Mechanical Engineer,* has now been elected president to succeed A. A. Helwig, resigned.

CLARENCE D. HICKS, president of the R & C Company, St. Louis, Mo., has also been elected vice-president of the Union Railway Equipment Company, in charge of sales in the southern and southwestern districts.

D. P. MORGAN, who recently resigned as railroad representative of the Garlock Packing Company at Philadelphia, Pa., has become southeastern manager of the Okadee Company and its associate company, the Viloco Railway Equipment Company, with headquarters in Atlanta, Ga.

G. F. AHLBRANDT and W. W. Lewis have been appointed as assistant vice-presidents of The American Rolling Mill Company, and H. M. Richards has been appointed manager of the sheet and strip sales division.

THE DEVILBISS COMPANY, Toledo, Ohio, will hold training school classes, for painters and refinishers interested in learning the technique of spray painting and the use and care of spray-painting equipment, for periods of one week beginning August 23, September 27, October 25, November 15 and December 13.

W. H. BLACKMER has resigned as sales manager of the Laminated Shim Co., Inc., Long Island City, N. Y., to become vice-president and general manager of the Packless Metal Products Corporation, Long Island City, manufacturers of seamless flexible metal hose, packless fittings and other metal products.

MARSHALL M. COOLEDGE has been appointed sales representative of The Buckeye Steel Castings Company, with office at 50 Church street, New York. Mr. Cooledge is a graduate engineer, class of 1926, of the University of Illinois. He was connected with the Timken Roller Bearing Company in sales and engineering on the Pacific Coast, and later with the Joseph T. Ryerson & Son, Inc., in the St. Louis district, before joining the Buckeye organization.

H. M. ARRICK, who for the last 10 years has been associated with the American Rolling Mill Company, Middletown, Ohio, in various railroad sales capacities, has been appointed manager of the newly created district office of the Armco Railroad Sales Company. Mr. Arrick's headquarters will be in the Ambassador building, St. Louis, Mo.

THE STANDARD RAILWAY EQUIPMENT COMPANY and its associate, the Union Metal Products Company, have opened an office in the Terminal Tower, Cleveland, Ohio, in charge of J. H. Schroeder, who is assistant to the vice-president. Mr. Schroeder had been previously in charge of the St. Louis office of the above companies.

F. C. RITNER of the Carboloy Company, Incorporated, Detroit, Mich., has been appointed assistant to the president, in charge of special wear-resistant applications, new developments and special products. T. D. MacLafferty, formerly of the Detroit district office of the General Electric Com-

(*Continued on next left-hand page*)

pany, has been appointed assistant to the general sales manager, and H. C. Stone, formerly of the Newark office, now represents the Carboloy Company in Brooklyn, N. Y., and New York City territory.

The Consolidated Ashcroft Hancock Company, Inc., has been dissolved and absorbed by the parent corporation, Manning, Maxwell & Moore, Inc., New York. The Railway Sales Division of the Consolidated Ashcroft Hancock Company, Inc., has also begun operation as the Locomotive Equipment Division of Manning, Maxwell & Moore, Inc. This change affects only the operating details of the corporation. Manning, Maxwell & Moore, Inc., has always been the sole owner of the Consolidated Ashcroft Hancock Company, Inc.

J. L. Terry, president of the Q & C Co., has been elected also treasurer; M. Iseldyke, Jr., secretary since 1924, has been appointed vice-president; R. R. Martin, who has been with the company since 1915, having served in the capacity of auditor and assistant treasurer since 1924, has been elected secretary and assistant treasurer; all with headquarters at New York City. Lewis Thomas, district sales manager at Chicago, has been promoted to general sales manager with headquarters at Chicago. Prior to graduating from Lehigh University, Mr. Thomas was employed in maintenance and construction

(c) *Moffett*

Lewis Thomas

work on the Pennsylvania at Newcastle, Pa. Later, he was employed by Alexander Potter, consulting engineer at New York, to assist in the construction of water filtration plants. Later he was connected with the Crescent Portland Cement Company during the construction of its plant and by the Pennsylvania Engineering Works as resident engineer on the construction of a Bessemer plant and trackage at Bethlehem, Pa. From 1911 to 1914 he was engaged in contracting work at Minneapolis and from 1914 to 1918 served as senior civil engineer for the Interstate Commerce Commission. In the latter year he became a sales representative of the Dravo-Doyle Company, Pittsburgh, Pa., and in 1920 resigned to become sales representative of the Q & C Company at Chicago. In 1928 he was appointed district sales manager.

Obituary

Walter Cary, vice-president of the Westinghouse Electric & Manufacturing Co., died suddenly on July 2, from a heart attack at his home in New York City.

George P. Dirth, southwestern manager of the Okadee Company and the Viloco Railway Company, with headquarters at St. Louis, Mo., died suddenly at Springfield, Ill., on July 8.

William C. Stettinius, a director of the Worthington Pump and Machinery Corporation and other organizations, died in Baltimore, Md., at the age of 41.

Fitz William Sargent, chief engineer of the American Brake Shoe & Foundry Company, died on July 25 at his home in Mahwah, N. J., after a long illness, at the age of seventy-eight. Mr. Sargent was born at Philadelphia, Pa., January 4, 1859, and immediately after graduating from Lehigh University, with a degree of Civil Engineer in the class of 1879, became connected with the Rio Grande Construction Company and was in charge of a group of surveyors on location in connection with the locating and building of the Denver & Rio Grande. Following this, Mr. Sargent joined an engineering party and assisted in locating parts of the Mexican National Railway. Later, as resident engineer with the Norfolk & Western, he assisted in locating some of the track for that railroad. He continued in civil engineering work on railroads until 1884, at which time he went to the Chicago, Burlington & Quincy, with which company he remained until 1891, first as engineer of tests until 1886 and then as mechanical engineer. While with the Burlington Mr. Sargent participated in the now famous Burlington Brake Trials which determined the type of freight brake equipment since used on the railroads in this country. It was the experience on these brake trials which first interested him in braking problems and lead him into the field of brake-shoe engineering. As one of the first steps in brake-shoe engineering, Mr. Sargent, in 1889, built a small brake-shoe testing machine in the laboratory of the Burlington at Aurora, Ill. This machine tested miniature brake shoes 4 in. long by 1 in. wide on an 11½-in. diameter chilled-iron wheels. Tests made on this small machine furnished information relative to brake-shoe characteristics which proved to be of great value in establishing braking practice. Later Mr. Sargent co-operated with the Master Car Builders Committee in an important group of tests, the results of which were published in the Master Car Builders Proceedings for 1894. One of the most valuable results of these early tests made by Mr. Sargent was the construction of the Master Car Builders Brake Shoe Testing Machine on which full sized brake shoes could be tested. This machine, first installed at the plant of the Westinghouse Air Brake Company at Wilmerding, Pa., was transferred in 1898 to the laboratory of Purdue University. In 1891 Mr. Sargent resigned his position with the Chicago, Burlington & Quincy and became identified with the Congdon Brake Shoe Company of Chicago. In 1893 he became chief engineer of the Sargent Company, Chicago, and remained in that capacity until 1902, when the American Brake Shoe & Foundry Company was formed, at which time Mr. Sargent became its Chief Engineer. From the time Mr. Sargent became actively connected with the brake-shoe business he has had a part in every important development that has been made in brake shoes. He was largely responsible for the perfection of the expanded metal (Diamond-S) type of brake shoe, which was originally brought out in 1897. This development contributed largely to the structural strength and the wearing quality of brake shoes. He also had a large part in the development of the steel back reinforcement which was likewise a great contribution to safety as well as to the durability of the brake shoe. He also developed a special metal insert used in driver

F. W. Sargent

brake shoes and through his continued research in brake shoe problems has contributed many other important improvements. Shortly after becoming associated with the American Brake Shoe & Foundry Company he developed an improved full size brake-shoe testing machine, which was installed at this company's Mahwah, N. J., plant in 1908 and which machine he revised from time to time in order to keep pace with the ever-changing railroad conditions. An entirely new machine of this type, with greatly increased capacities for brake shoe and wheel loads and a materially increased speed range, only a little more than a year ago was installed in a new research laboratory built by the American Brake Shoe & Foundry Company at Mahwah, N. J., and fittingly named in honor of Mr. Sargent. Mr. Sargent was a member of the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Society for Testing Materials. He was the author of the "Development of the Modern Brake Shoe" and "Motor Car Builders Brake Shoe Tests" and numerous railway club papers.

Henry S. Demarest, president and treasurer of Greene, Tweed & Co., N. Y., died at his home in Hempstead, N. Y., on July 11, at the age of 70. Since 1900, he had been associated with the company.

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Personal Mention

General

C. T. Ripley, chief mechanical engineer of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, has taken a leave of absence.

J. P. Morris, master mechanic of the Atchison, Topeka & Santa Fe at Chicago, has been appointed to the newly-created position of mechanical assistant in the general office at Chicago.

Ernest R. Lind has been apponted general mechanical inspector of the Northern Pacific, with headquarters at St. Paul, Minn., to succeed R. P. Blake, retired.

H. E. Hinds, chief draftsman (locomotive) of the Chicago, Burlington & Quincy, has been appointed assistant mechanical engineer, with headquarters as before at Chicago.

H. M. Wood, assistant master mechanic of the Pittsburgh division of the Pennsylvania at Pittsburgh, Pa., has been appointed assistant engineer, motive power, office of general superintendent motive power, Eastern Region with headquarters at Philadelphia, Pa.

J. M. Nicholson, master mechanic on the Atchison, Topeka & Santa Fe at Chicago, has been appointed acting mechanical superintendent of the Western Mechanical district of the Eastern lines, with headquarters at Topeka, Kan., replacing I. C. Hicks, who has been granted a leave of absence because of ill health.

Master Mechanics and Road Foremen

W. P. Hartman master mechanic of the Atchison, Topeka & Santa Fe at Slaton, Tex., has been transferred to Argentine, Kan.

Paul J. Danneberg, general foreman of the Atchison, Topeka & Santa Fe at Argentine, Kan., has been promoted to master mechanic of the Slaton division of the Panhandle & Santa Fe (part of the Santa Fe System), with headquarters at Slaton, Tex.

W. Ellison has been appointed acting division master mechanic of the Canadian National, with jurisdiction over Toronto Terminals—Toronto to Niagara Falls and Toronto to Fort Erie—succeeding W. Sharp, who has been granted a leave of absence.

Car Department

A. Leduc has been appointed car foreman of the Canadian National at Brockville, Ont., succeeding J. A. Hueston, retired.

C. F. Weaver, district car foreman of the Canadian National at Montreal, Que., has been appointed superintendent of the car shop at London, Ont., succeeding T. M. Hyman, retired.

Shop and Enginehouse

T. Clegg, air brake inspector of the Canadian National at Winnipeg, Man., has retired.

A. McDonald, night foreman of the Canadian National at Kamloops Junction, B. C., has retired.

A. D. McMillan, locomotive foreman of the Canadian National at Rocky Mountain House, Alta., has been transferred to Mirror, Alta.

J. T. Walton, locomotive foreman of the Canadian National at Mirror, Alta., has been transferred to Rocky Mountain House, Alta.

G. H. Murdock, a machinist of the Canadian National at Kamloops Junction, B. C., has been promoted to the position of night foreman.

J. Phelan, air brake foreman of the Canadian National at Fort Rouge, Man., has been appointed air brake inspector, western region, with headquarters at Winnipeg, Man., succeeding T. Clegg, retired.

Purchasing and Stores

V. R. Naylor, general foreman of the Southern Pacific at West Oakland, Calif., has been appointed district material supervisor to succeed C. S. Jones.

S. Sneddon, assistant general storekeeper of the Canadian National, at Winnipeg, Man., has been appointed general storekeeper of the central region, with headquarters at Toronto, Ont.

R. D. Long, purchasing agent of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been appointed also general purchasing agent of the Colorado & Southern, the Fort Worth & Denver City and the Wichita Valley, all of which are subsidiaries of the Burlington.

Obituary

Joseph F. McAuley, division storekeeper on the Southern Pacific, with headquarters at Portland, Ore., died suddenly of a heart attack on June 21.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Bethlehem Steels.—"Mayari Staybolt Steel" and "Bethlehem Silico-Manganese Spring Steel" are the subjects of Folders 386 and 387 issued by the Bethlehem Steel Company, Bethlehem, Pa.

Boring Bars and Reamers.—Specifications, prices and descriptions of Gisholt boring bars and reamers are contained in the eight-page illustrated bulletin issued by the Gisholt Machine Company, Madison, Wis.

Oil-Burning Rivet Forges.—Johnston Type A rivet forges equipped with non-clogging vacuum oil burners and monolithic fire brick linings are illustrated and described in Bulletin No. 200C issued by the Johnston Mfg. Co., Minneapolis, Minn.

Vascoloy-Ramet Tools and Blanks.—The Vanadium-Alloys Steel Company, Vascoloy-Ramet Division, North Chicago, Ill., has issued a catalog of tools and blanks which contains much useful data for tool makers using carbide blanks, or machine shops using tools tipped with these blanks.

Wrought-Steel Wheels and Axles—A symbolic replica of a wrought steel wheel is embossed on the front cover of a book entitled "USS Wrought-Steel Wheels and Axles" issued by the United States Steel Corporation Subsidiaries, 434 Fifth Avenue, Pittsburgh, Pa. The book is addressed to "The Safest Carrier in the World"—the railroads of today—and contains sections on wheels for steam railway service, wheels for electric railway service and forged steel axles

Steel Shop Boxes.—An attractive catalog, entitled Steel Shop Boxes, has been published by Lyon Metal Products, Incorporated, Aurora, Ill. This catalog completely illustrates and describes a wide range of steel boxes for every manufacturing and storage use—shelf boxes for the storage of small parts; shop and tote boxes for transportation of work in process by truck, conveyor or lift truck; stacking boxes, nesting boxes; and suggestions for the use of special steel containers designed to be used with specific production systems. In addition, the catalog contains brief descriptive matter on steel shelving, lockers, shop equipment and tool storage equipment.

Timken Bearings.—The 32-page folder, issued by the Railroad Division of the Timken Roller Bearing Company, Canton, Ohio, in timetable style, illustrates many applications of Timken bearings to railroad equipment. Eleven full-page cutaway illustrations show driver, truck and car applications now in standard service. Other illustrations show and describe various types of locomotives which have been Timken-equipped, as well as Diesel and steam powered, streamline high-speed trains. Timken light-weight reciprocating parts are described and easily read graphs show how Timken bearings reduce starting and operating friction and hold operating temperatures within safe limits, as well as how Timken rods and reciprocating parts reduce dynamic augment.